THE CANADIAN ANAESTHETISTS' SOCIETY JOURNAL

Vol. 7, No. 2 APRIL, 1960

JOURNAL DE LA SOCIÉTÉ CANADIENNE DES ANESTHÉSISTES

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1. Webster, C.W., C.M.A.J. Oct. 1953.

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1. Taheri, Z. E.: Urevert in Cranial Trauma and Brain Surgery, J. Internatl. College of Surgeons 32:389 (Oct.) 1959. 2. Javid, M.: Urea—New Use of an Old Agent, Reduction of Intracranial and Intraocular Pressure, The Surgical Clinics of North America, Philadelphia, W. B. Saunders Company, Aug. 1958, p. 907. 3. Marsh, J. S., and Anderson, F. M.: The Intravenous Use of Urea for Control of Intracranial Hypertension, Bull. Los Angeles Neurol. Soc. 24:174 (Sept.) 1959.

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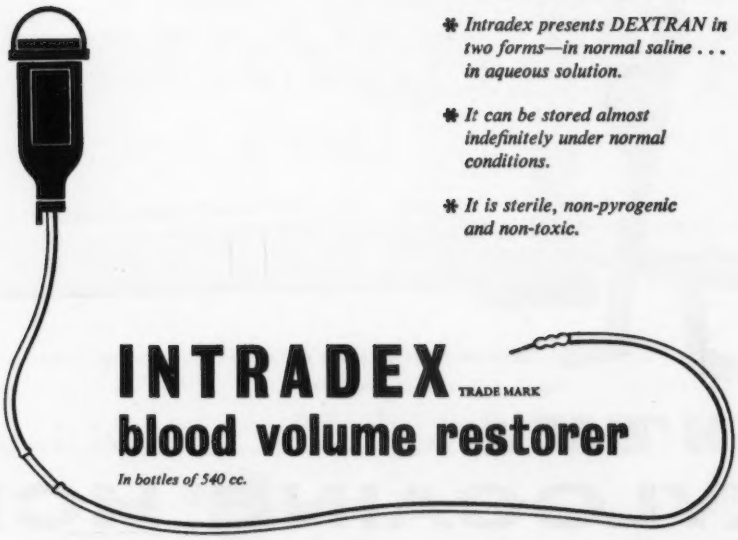

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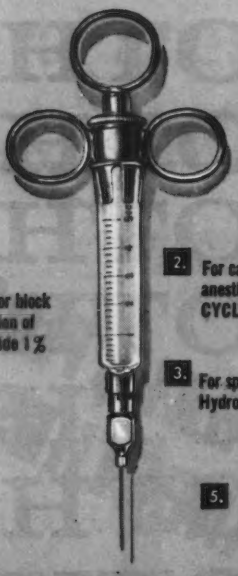

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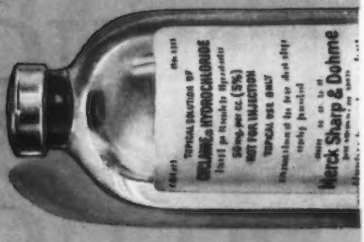

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PREVENTS OR QUICKLY RELIEVES
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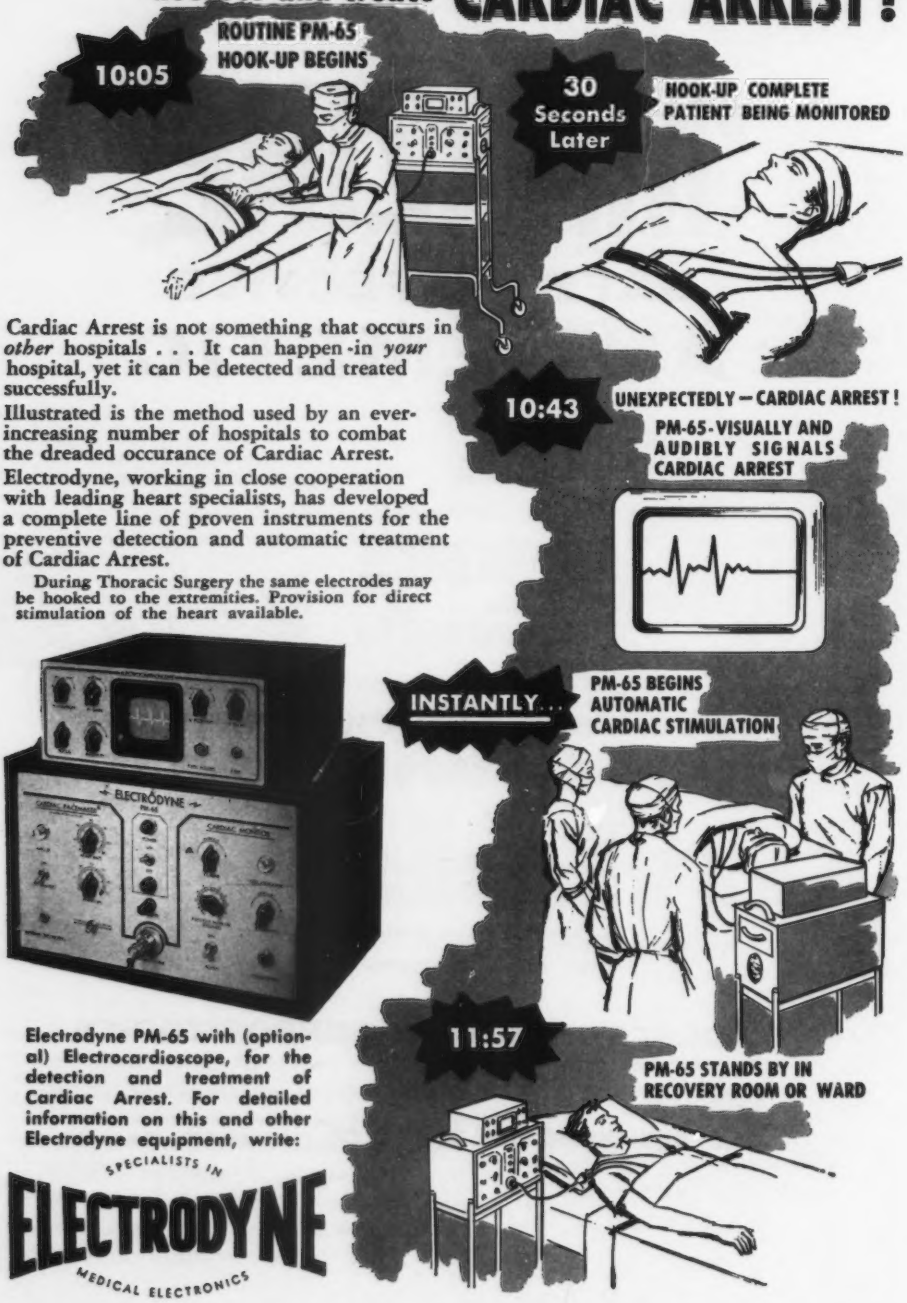

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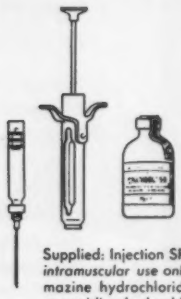

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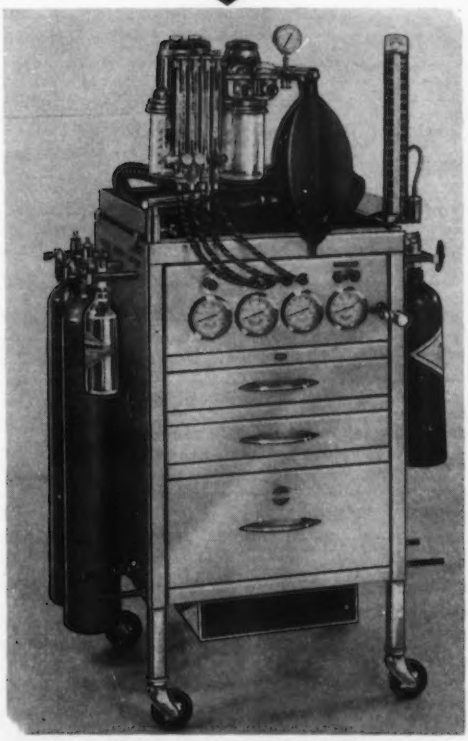

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FORM C **FORMULE C**

APPLICATION FOR ENROLMENT
DEMANDE D'INSCRIPTION COMME MEMBRE

TO:
A: The Manager,
Second World Congress of Anaesthesiologists,
2 College St.,
Toronto 5, Ontario, Canada.

I wish to enrol as an active member of the Second World Congress of Anaesthesiologists, to be held in Toronto, Ontario, Canada, September 4th to 10th, 1960.

Je désire m'inscrire comme membre actif du Deuxième Congrès Mondial des Anesthésistes, qui aura lieu à Toronto, Ontario, Canada, du 4 au 10 septembre, 1960.

PLEASE PRINT IN BLOCK LETTERS — EN CAPITALES D'IMPRIMERIE, S'IL VOUS PLAIT

SURNAME
NOM .....

CHRISTIAN OR GIVEN NAMES
PRENOMS .....

ADDRESS
ADRESSE .....

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ACADEMIC APPOINTMENT OR AFFILIATION
SITUATION ACADÉMIQUE OU ASSOCIATION ....

LANGUAGE PREFERENCE
LANGUE CHOISIE .....

Are you attending as the representative of any Government, Society or Organization?
If so, please specify .....

.....

Participez-vous comme représentant d'un Gouvernement, d'une société ou d'une organisation quelconque? Si oui, veuillez préciser

.....

I shall be accompanied by the following associate members
Je serai accompagné par les membres associés suivants .....

.....

(Names) (Noms)

FEES: Active Membership: $25.00 Canadian payable before March 31, 1960, or $30.00 if submitted after March 31, 1960.

Associate Membership: $10.00 Canadian payable before March 31, 1960, or $15.00 if submitted after March 31, 1960.

I enclose money order or bank draft for $..... payable in Canadian funds.

Enrolment fees will be returned to those unable to attend the Congress who so notify the Manager prior to August 1, 1960.

DROITS D'INSCRIPTION: Membre Actif: Dollars canadiens $25.00 à toucher avant le 31 mars, 1960; $30.00 si présenté après le 31 mars, 1960.

Ci-joint un mandat ou un chèque pour $..... payable en dollars canadiens.

Les droits d'inscription seront remboursés à ceux qui ne pourront pas assister au Congrès, et qui en avertiront l'Organisateur avant le 1er août 1960.

Date .....

NOTE: Forms for requesting hotel accommodations will be sent at a later date to all who return this form.

Signature .....

NOTE: Les formes pour les réservations d'hôtel seront envoyées plus tard aux personnes qui auront retourné cette forme.

SEGUNDO CONGRESO MUNDIAL DE ANESTESIOLÓGOS
ZWEITER WELTKONGRESS DER ANAESTHESIOLOGEN

FORMA C — FORMULAR C

SOLICITUD DE PERMISO PARA PARTICIPAR EN EL CONGRESO
ANMELDUNG ZUR TEILNAHME

DIRIGIDA A:

AN: The Manager,
Second World Congress of Anaesthesiologists,
2 College St.,
Toronto 5, Ontario, Canada.

Deseo registrarme como miembro activo del Segundo Congreso Internacional de Anestesiológos que tendrá lugar en Toronto, Ontario, Canadá, desde el día 4 hasta el día 10 de septiembre de 1960.

Ich wünsche als aktives Mitglied am zweiten Weltkongress der Anaesthesiologen teilzunehmen, der vom 4. bis 10. September 1960 in Toronto, Ontario, Canada, stattfinden wird.

HÁGASE EL FAVOR DE IMPRIMIR EN MAYÚSCULAS — BITTE IN DRUCKSCHRIFT AUSZUFÜLLEN

APELLIDO
FAMILIENNAME .....

NOMBRE DE BAUTISMO O DE PILA
VORNAME(N) .....

DIRECCIÓN POSTAL
ADRESSE .....

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AKADEMISCHE STELLUNG ODER BEZIEHUNG .....

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BEVORZUGTE SPRACHE .....

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Nehmen Sie als Vertreter einer Regierung, Vereinigung oder Organisation teil? Im Bejahungsfalle bitte um genaue Angabe.

.....

Los siguientes colegas me acompañarán .....

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(Nombres)

Ich werde von den folgenden Mitgliedern begleitet werden .....

.....

(Namen)

CUOTAS:

Miembro activo: $25.00 (moneda canadiense) pagaderos antes del 31 de marzo de 1960, o $30.00 (moneda canadiense) entregados después del 31 de marzo de 1960.

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Adjunto letra de cambio o giro en $..... pagaderos en moneda canadiense.

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Fechada en
Datum .....

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Beiliegend Postüberweisung oder Bankwechsel für $..... zahlbar in kanadischer Währung.

Anmeldegebühren werden im Falle einer Verhinderung der Teilnahme am Kongress zurückerstattet, wenn die Kongressleitung vor dem 1. August 1960 hiervon benachrichtigt wird.

Firma
Unterschrift .....

ANMERKUNG: Formulare zur Anforderung von Hotelzimmern werden später an alle Einsender dieses Formulars versandt werden.

NOTICE

RESIDENTS IN ANAESTHESIA

The Organizing Committee for the Second World Congress of Anaesthesiologists of the World Federation of Societies of Anaesthesiologists has arranged a

SPECIAL CONGRESS REGISTRATION FEE FOR RESIDENTS IN ANAESTHESIA

This fee is $10.00 (Canadian) and should be forwarded to the following address:

Manager
Second World Congress of Anaesthesiologists
2 College St.
Toronto 2, Ontario, Canada

The Registration must be accompanied by a certificate in the following form signed by the Chief of the Department of Anaesthesia in which the Resident is training:

To: *Second World Congress of Anaesthesiologists*

I hereby certify that .....
(*Name*)

is a Resident in training in Anaesthesia, and entitled to the benefit of the special registration fee for Residents attending the Congress.

..... M..D
(*Signature*)

Chief, Department of Anaesthesiology

..... Hospital

.....
(*Address*)

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THE CANADIAN ANAESTHETISTS' SOCIETY JOURNAL

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THE CARDIOVASCULAR EFFECTS OF AZEOTROPIC HALOTHANE-ETHER[1]

GORDON M. WYANT, F.F.A.R.C.S., JOHN E. MERRIMAN, F.R.C.P.(C), JOHN H. HARLAND, M.B., and HARRY V. DONALDSON, M.D.[2]

THE AZEOTROPIC MIXTURE of halothane-ether was first described by Hudon, Jacques, and Boivin in 1958 (1–4). On the basis of their preliminary reports the mixture seemed to have sufficient advantages to merit extensive clinical and experimental investigation.

When this present study was undertaken, some clinical experience with the azeotropic mixture as an adjunct to nitrous oxide anaesthesia had been gained already in our institution (5). We had found the mixture more easily controllable than halothane and less depressing to cardiorespiratory function. Further clinical experience with azeotropic halothane-ether as a supplement to nitrous oxide has permitted us to discard calibrated vaporizers and to administer the mixture from the ether or trichlorethylene bottle of any standard anaesthesia machine. In long cases, we have found the azeotrope superior to trichlorethylene in that awakening is more rapid and cardiac irregularities have rarely occurred. Because of these apparent advantages a controlled study seemed indicated.

METHOD

Experiments carried out on seven healthy unpremedicated male volunteers were designed in a manner similar to that described in a previous communication (6). Cardiac output as well as peripheral and pulmonary artery pressures was measured and recorded, total peripheral and pulmonary resistances were calculated, vein-to-artery circulation time was determined, and the electrocardiogram and electroencephalogram were monitored and recorded.

At least two control cardiac output determinations were done and all control values were recorded. Control cardiac output measurements by the dye method were compared with simultaneous Fick determinations. Anaesthesia was induced with small doses of 2.5 per cent sodium thiopental until smooth maintenance of anaesthesia with the azeotropic mixture alone became possible. The mixture was administered from a Fluotec vaporizer in a semi-closed system using a 10 L./min. flow of oxygen. The concentration of the mixture was gradually increased until 3 per cent was reached. Thereafter, the concentration of the mixture was progressively increased still further by administering it from the copper kettle of a Foregger machine. If no significant changes occurred, the flow of oxygen was

[1]Presented at the Annual Meeting of the Canadian Anaesthetists' Society, Seigniory Club, Montebello, P.Q., May 4–7, 1959.

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decreased and some rebreathing with carbon dioxide absorption was permitted until maximum hypotension, compatible with safety, had been obtained. Respiration was controlled when it became inadequate. Endotracheal tubes were not used.

After maximum hypotension had been reached and the various parameters had been measured and recorded, administration of the mixture was discontinued, and the subject was allowed to wake spontaneously. Cardiac output and other measurements were made at various stages throughout the experiment.

Results

Two representative cases are discussed in detail.

Case 1 (Fig. 1)

This was a 23-year-old man, 72½ in. tall and weighing 174 lb. He required a total of 0.5 gm. thiopental in small subdivided doses and induction was complete in 2 min. His systemic blood pressure on induction was 110/65 mm. Hg. There was an initial slight rise in systolic pressure followed by a fall to 85/45 mm. Hg as soon as a concentration of 3 per cent had been reached and this approximate level was maintained for the next 25 min. There was no significant change in pulmonary artery pressure which remained constant at an average of 18/4 mm. Hg. At the end of this period cardiac output was determined. This showed a slight fall to a little over 6 L. from a control value of 8 L.—a fall proportional to the lower plateau of systemic pressure then prevailing. The electroencephalogram at this time showed a pattern compatible with relatively light surgical anaesthesia. There was no change in vein-to-artery circulation time of 10 sec., and both peripheral and pulmonary resistances remained essentially equal to control values. The 3 per cent output of the Fluotec vaporizer was now supplemented by vapour from the copper kettle using an additional oxygen flow of 100 ml. per minute which was gradually increased over the next 5 min. to 1,200 ml. There was a slight rise in brachial systolic pressure 9 min. later due to the fact that the copper kettle had to be temporarily discontinued for re-filling. There followed a sudden fall in systemic pressure which coincided with inadequacy of respiratory exchange necessitating manual ventilation. The systolic pressure fell to 51/33 mm. Hg. Two minutes later the pulmonary artery pressure had reached a peak of 35/15 mm. Hg following a gradual rise from the time the copper kettle was added to the system. Cardiac output at this time was 3.6 L., vein-to-artery circulation time was prolonged to 16 sec., total peripheral resistance had not significantly changed, but total pulmonary resistance had increased from a control value of 120 dynes/sec./cm.$^{-5}$ to 465, that is, almost fourfold. The electroencephalogram at this stage showed a level of anaesthesia compatible with gradually deepening anaesthesia. By the time all determinations had been completed, with the copper kettle shut off, the blood pressure had again returned to 110/65 mm. Hg followed by a decline of pulmonary artery pressure to 22/15 mm. Hg. The copper kettle was immediately turned full on again and within 6 min. hypotension had again been obtained. The dye curve at this time showed very marked prolongation of vein-to-artery circulation time to 24 sec., and the curve was so flat that output could not be properly calculated. The electroencephalogram showed almost complete burst suppression, comparable to ether anaesthesia level 6 to 7. Azeotropic halothane-ether was now finally discontinued and following return of adequate spontaneous respirations, the subject was allowed to breathe air. The systemic pressure immediately returned to 104/53 mm. Hg, gradually declined and then rose again slowly while oxygen was being administered. Simultaneous with the fall of systemic pressure there was a return of the pulmonary artery pressure to just below pre-anaesthetic levels where it remained until the end of the experiment. A cardiac output taken while oxygen was being administered showed that this had

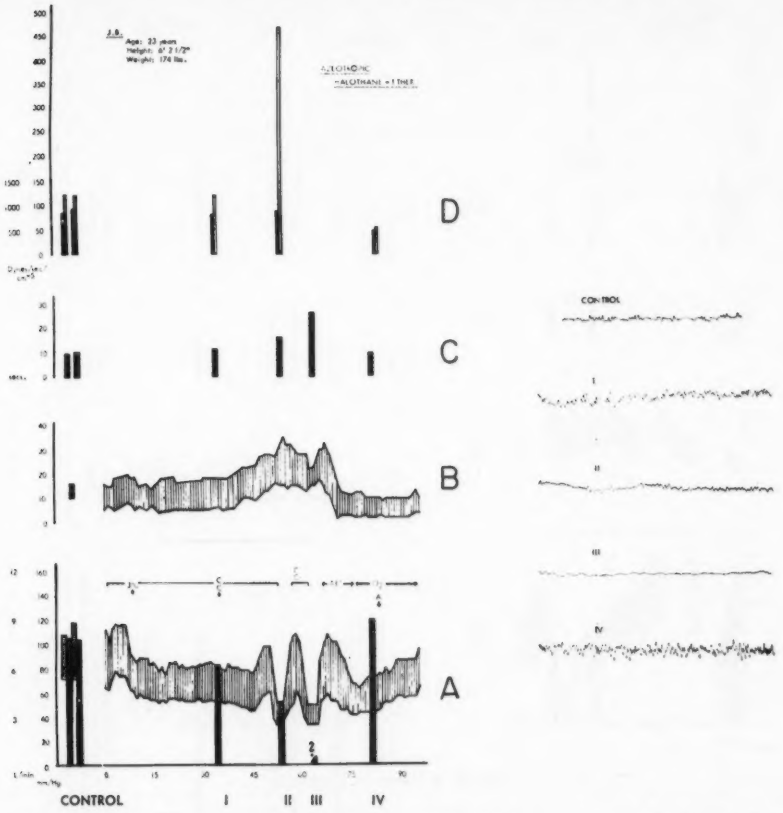

FIGURE 1. A. Systemic blood pressure in mm. Hg (pulse pressure shaded). Cardiac output (black bars) in L./min. Bracket denotes duration of administration of azeotropic halothane-ether. The time when 3% concentration was reached and when the copper kettle was introduced into the system is marked by "3%" and "CC" respectively. B. Pulmonary artery pressure in mm. Hg. C. Vein-to-artery circulation time in seconds. D. Total systemic resistance (black bars; scale on left) and total pulmonary resistance (white bars; scale on right); both in dynes/sec./cm.$^{-5}$. Numbers in the bottom line refer to the identically numbered E.E.G. tracing on the right.

risen to 9 L. with circulation time back to normal. At 465 and 53 dynes/sec./cm.$^{-5}$ respectively, both pulmonary and systemic resistances had fallen below control levels. The electroencephalogram at this time showed a pattern indicative of very light anaesthesia.

Case 2 (Fig. 2)

This was a 25-year-old healthy young man, 69½ in. tall, and weighing 146 lb. In this case, induction was very stormy and prolonged lasting 13 min. and requiring a total of 750 mg. thiopental and a high flow of oxygen through the copper kettle before induction was complete. At that time, the systemic blood pressure was almost identical to the control level, namely 135/82 mm. Hg, the pulmonary artery pressure having

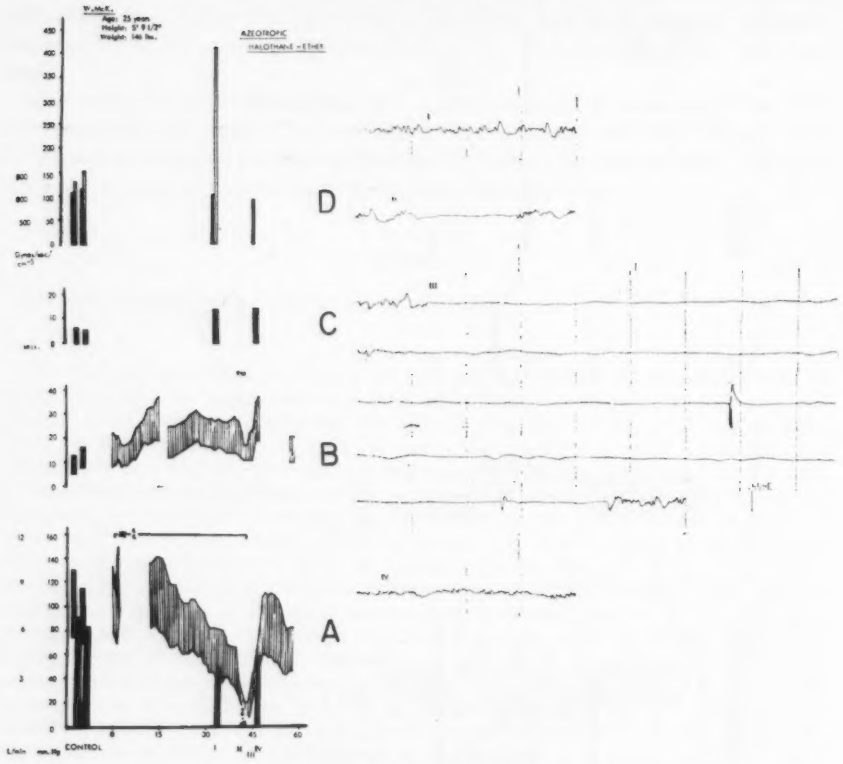

FIGURE 2. Same as Figure 1.

risen markedly to 33/18 mm. Hg presumably because of the very stormy induction. At the time induction was complete the patient had been on the copper kettle for 5 min. and within another 7 min. a gradual decline in systemic blood pressure took place, until 33 min. after the start of the experiment it had reached 82/46 mm. Hg. Pulmonary artery pressure was then 28/16 mm. Hg, a marked elevation over the control value of 17/9 mm. Hg. Cardiac output had fallen markedly to 3.7 L., the vein-to-artery circulation time was prolonged to 13 sec., but total peripheral resistance was not greatly changed. Total pulmonary resistance however, had reached 410 dynes/sec./cm.$^{-5}$. At this stage, every second breath was assisted and the electroencephalogram showed a pattern of moderate depth. After the output determination had been completed, respiration was controlled and quite soon there was a precipitous fall in systemic blood pressure to 42/27 mm. Hg and beyond, with a subsequent fall in pulmonary artery pressure to 17/11 mm. Hg 2 min. later. Cardiac output at that time could not be recorded because of the flat curve and the electroencephalogram showed a pattern of very deep anaesthesia with 8 sec. burst suppression. An electroencephalogram carried out immediately after the cardiac output determination had been completed showed complete burst suppression for 2 min., 25 sec., and the administration of the azeotropic mixture was discontinued and oxygen was administered. This was followed by a sharp rise in systemic and pulmonary artery pressures, a cardiac output of 4 L. being recorded with circulation time and peripheral resistance comparable to those previously established for

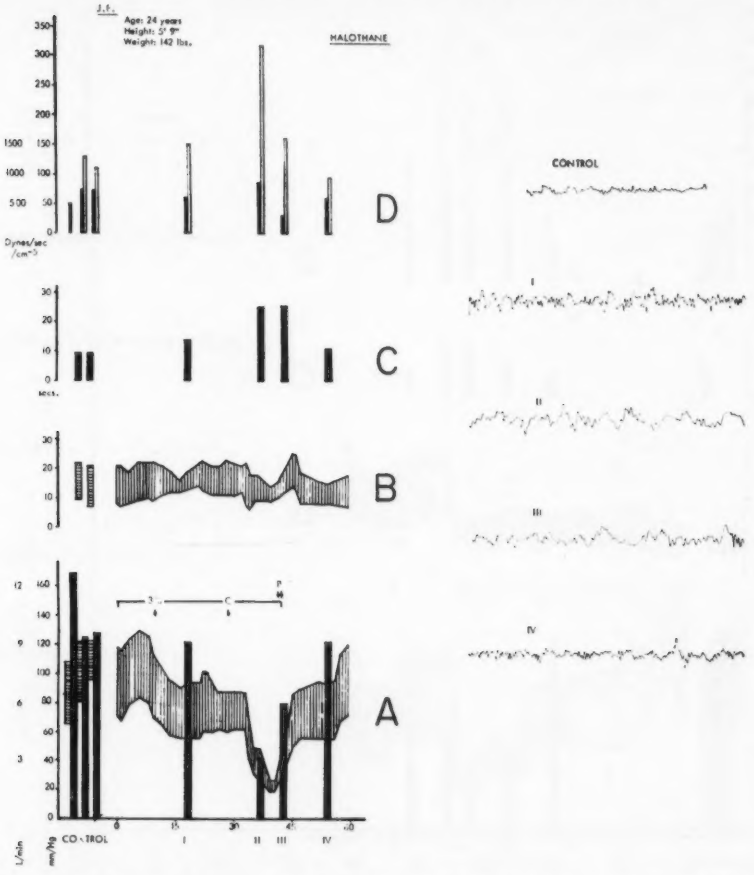

FIGURE 3. Same as Figure 1, but for azeotropic halothane-ether read "halothane." C: system closed; P: phenylephrine given.

a comparable systemic blood pressure. Systemic artery pressure continued to rise to 112/58 mm. Hg and then gradually declined to 83/45 mm. Hg towards the end of the experiment.

COMPARISON WITH HALOTHANE (6) AND DISCUSSION

In order to obtain profound hypotension with the azeotropic mixture, it had to be administered through a more potent vaporizer than the Fluotec. Indeed, the copper kettle was required in the "full-on" position and respiration had to be controlled before deep hypotension could be achieved. With halothane on the other hand, all that was required was a short period of controlled respiration in a closed system with the Fluotec vaporizer at 3 per cent to produce precipitous

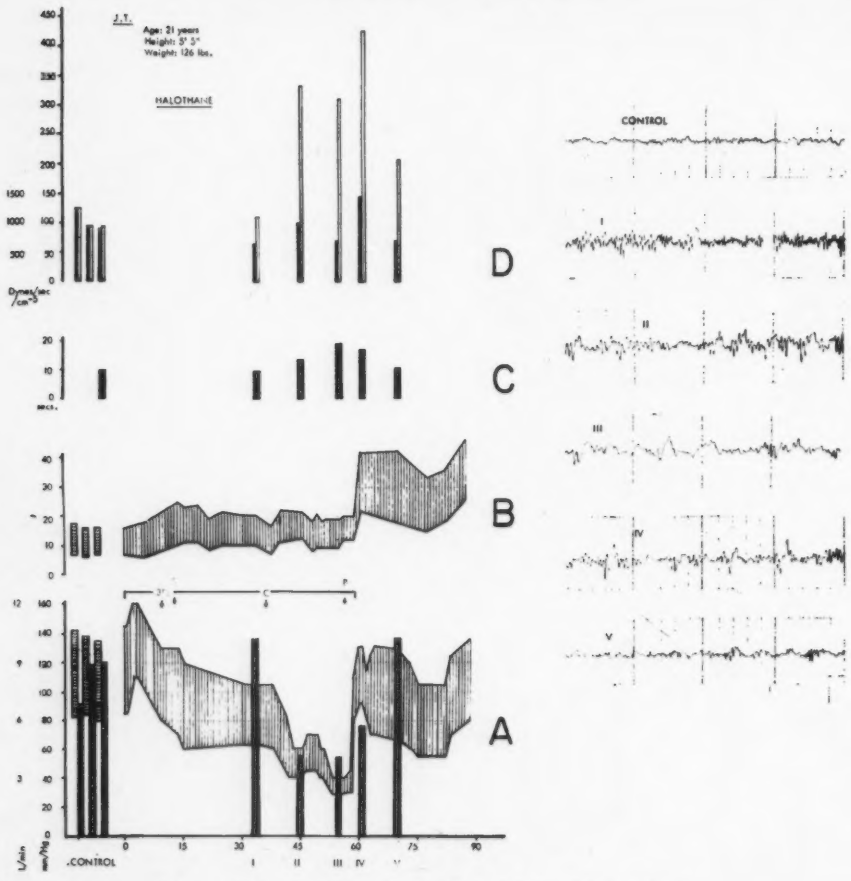

FIGURE 4. Same as Figure 3. S: succinylcholine 10 mg. given.

hypotension. In order to allow for comparison, two previously published tracings of the halothane experiment are reproduced with electroencephalograms added (Figs. 3, 4). From these tracings it is obvious that hypotension with halothane-ether occurs only when very deep anaesthesia is reached, and in that respect the mixture is comparable to ether. With halothane on the other hand, the electro-encephalogram shows relatively light anaesthesia at a time when equally profound hypotension is evident.

The changes in *cardiac output* under the azeotropic mixture are consistent with the degree of blood pressure fall obtained and thus parallel depth of anaesthesia (Fig. 5). Only during emergence from anaesthesia is this relationship not consistently maintained. In four instances high cardiac output is associated with persistent reduction of mean systemic blood pressure which indicates residual peripheral dilatation.

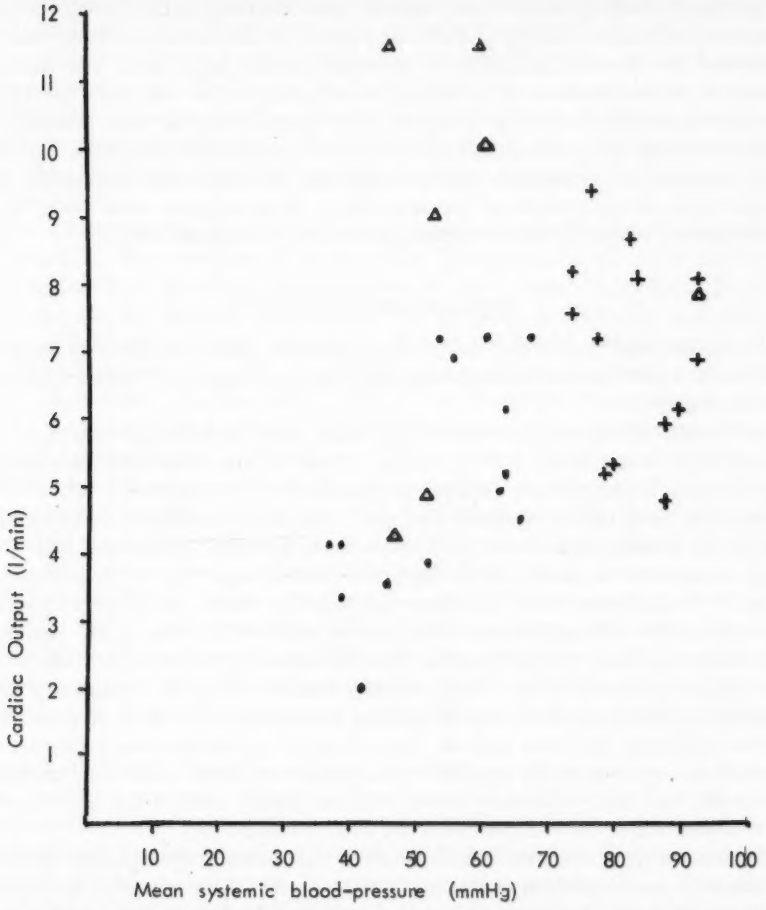

FIGURE 5. Scattergram relating mean systemic blood pressure to cardiac output under anaesthesia with azeotropic halothane-ether. +—control values; •—during maintenance; Δ—during emergence.

The prolongation of *vein-to-artery circulation* time is proportional to the cardiac output, although this prolongation is not quite as pronounced as with halothane anaesthesia. A rise of *pulmonary artery pressure* under halothane-ether is a consistent finding whereas this was not so under halothane alone. Under halothane anaesthesia there was a definite diminution of *peripheral resistance*, indicating peripheral vasodilatation as the plateau of mild hypotension was reached, but this is not evident with the mixture. However, the marked rise in *total pulmonary resistance* was found with both agents. The significance of this is not yet clear and further studies are now in progress in an attempt to elucidate this phenomenon.

The electrocardiogram revealed a split P wave once at the time when the blood pressure had reached its lowest level. Bigeminal rhythm developed twice and was corrected by the administration of procaine amide. Both times the incidence occurred in the presence of a normal blood pressure; in one case the highest concentration of the azeotrope from the copper kettle had just been attained. The experiment was discontinued and this case is not included in this series. The other case occurred on emergence with oxygen and on controlled respiration some 5 min. after discontinuance of the anaesthesia. Both subjects were being or had been exposed to greatly excessive concentrations of the anaesthetic.

Summary and Conclusions

Azeotropic halothane-ether has a less profound effect on the cardiovascular system than halothane alone. Consequently, less rigid control of vapour concentration is needed.

Following induction of anaesthesia, the blood pressure falls slightly to a plateau, where it tends to remain. Fall in cardiac output is proportional to the degree of hypotension. No significant changes in pulmonary artery pressure, vein-to-artery circulation time, total peripheral and total pulmonary resistance are evident at this stage. Further depression of systemic blood pressure occurs only when very deep anaesthesia is produced by deliberate overdosage. This is in marked contrast to the findings under halothane anaesthesia, where similar hypotension is associated with only moderate depth of anaesthesia. In this respect, the azeotropic mixture more closely resembles ether than halothane. Cardiac output falls to very low values as the systemic blood pressure reaches its nadir. Pulmonary artery pressure gradually rises during deepening of anaesthesia and as respiration requires assistance and later control. Vein-to-artery circulation time increases with increasing hypotension. No significant changes are apparent in the total peripheral resistance, but total pulmonary resistance rises greatly and, at the time of maximum hypotension, may be four times the control value.

During emergence from halothane-ether anaesthesia the relation of blood pressure to cardiac output is less strict than during maintenance. The development of bigeminal rhythm is a definite possibility if concentrations of the agent are grossly excessive. No significant electrocardiographic changes were observed at other times.

Résumé

Pour préciser les effets cardiovasculaires de l'halothane-éther azéotropique, nous avons fait des expériences sur sept volontaires masculins en santé et non prémédiqués.

Nous avons mesuré la pression sanguine pulmonaire et systémique, le débit cardiaque, le temps de circulation veine à artère et la résistance total périphérique ainsi que la résistance pulmonaire de la même façon que nous avons décrite dans une communication antérieure traitant des effets cardiovasculaires de l'halothane. Au cours de chacune des expériences, l'électrocardiogramme et l'électroencéphalogramme étaient en marche. Ces circonstances expérimentales nous permet-

tent de comparer l'anesthésie avec le mélange azéotropique halothane practiqué dans les mêmes conditions et de tirer les conclusions suivantes:

L'anesthésie au mélange azéotropique halothane-éther affecte moins le système cardiovasculaire que l'halothane seul. En conséquence, le mélange exige un contrôle moins rigoureux de la concentration de ses vapeurs. Toutefois, le mélange est moins puissant ce qui rend l'induction de l'anesthésie plus difficile, particulièrement chez les jeunes volontaires en santé et non prémédiqués employés pour cette étude.

Après l'induction de l'anesthésie, la tension artérielle tombe légèrement jusqu'à un plateau où elle a tendance à se maintenir. La diminution du débit cardiaque est proportionnelle au degré d'hypotension. A cette phase d'anesthésie, il n'apparaît pas de modifications importantes de la pression artérielle pulmonaire, du temps de circulation veine à artère, de la résistance périphérique totale ni de la résistance pulmonaire totale. Une chute plus marquée de la tension artérielle n'apparaît seulement lorsque nous produisons une anesthésie très profonde par un surdosage calculé. Cela représente un contraste frappant avec les résultats obtenus au cours de l'anesthésie à l'halothane où nous avons observé une hypotension semblable avec un niveau d'anesthésie plus superficiel. Sous cet angle, le mélange azéotropique ressemble plus à l'éther qu'à l'halothane. Le débit cardiaque tombe à des chiffres très bas lorsque la pression artérielle systémique atteint son nadir. Dans l'artère pulmonaire, la pression s'élève graduellement à mesure que s'approfondit l'anesthésie et que la respiration requiert de l'assistance et plus tard du contrôle. Le temps de circulation veine à artère s'allonge selon que s'aggrave l'hypotension. Il n'y a pas de modifications importantes de la résistance totale périphérique mais la résistance pulmonaire totale s'élève considérablement et, au moment de l'hypotension maxima, cette résistance peut quadrupler celle des témoins.

Durant le réveil de l'anesthésie halothane-éther, le rapport tension artérielle et débit cardiaque est moins rigoureux que durant le maintien de l'anesthésie. A l'électrocardiogramme, on n'observe que peu de changements importants même sous anesthésie profonde, ce qui fait un contraste avec les observations faites durant l'anesthésie à l'halothane. Si, pourtant, excessif grandes doses d'azéotrope sont administrées, c'est vraisemblablement que la rhythme bigeminie surviendrait.

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FLUOTHANE-ETHER IN ANAESTHESIA FOR PULMONARY SURGERY

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Since the beginning of February, 1958, the Fluothane-ether azeotropic mixture has been used with satisfaction in the Department of Anaesthesia of Laval Hospital. By the end of April, 1959, we had used it in 241 pulmonary surgical cases, in patients of various ages, using different machines and techniques. The sole aim of this summary is to describe our clinical experience with Fluothane-ether, especially in pulmonary anaesthesia, and then to show the numerous advantages of the method which, at least in our hands, has helped to reduce surgical and anaesthetic hazards.

General Considerations

The combination of volatile anaesthetics is well known, especially to practising physicians. Although they are not perfect, the combinations of ethyl chloride and ether, Vinethene and ether, and especially chloroform and ether, are still used in daily medical practice. However, in modern hospital centres, where specialists work together in the departments of anaesthesia, suitable anaesthetic mixtures are required and desirable. Thanks to Professor Fernando Hudon and his colleagues we have the ideal volatile anaesthetic mixture called Fluothane-ether azeotropic mixture, which is composed of ether 31.7 vol. per cent, Fluothane 68.3 vol. per cent, with a common boiling point of 51.5° C., having a concomitant action. The clinical results obtained with this new mixture have proved very interesting in general surgery. According to the authors, "an improved anaesthesia which should be more and more used in the future" is obtained. At Laval Hospital, in an endeavour to improve our anaesthetic techniques and to investigate it further, we have undertaken the use of this azeotropic mixture in pulmonary and cardiac surgery. The cardiovascular studies in dogs had been encouraging, and our first clinical tests in pulmonary surgery being successful and stimulating, this modern method of anaesthesia has become a daily practice, especially in pulmonary surgery.

Clinical Experience

Statistics

As mentioned above, the Fluothane-ether azeotropic mixture was used (between February 1, 1958, and April 15, 1959) at Laval Hospital in 241 cases of pulmonary surgery. We carried out a total of 192 pulmonary resections, including 25 segmentectomies, 114 lobectomies, and 53 pneumonectomies. Moreover, there

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were 18 thoracoplasties, and 31 cases of bronchial aspirations and bronchographies (13) and costotomies (18). The patients varied in age from 2 to 69 years, the average age being 27 years.

Technique of Anaesthesia

It is a habit in our group to use a potent and mixed premedication: on the previous evening, a non-barbiturate hypnotic, Noludar® combined with the antihistamine Phenergan®; in the morning, Phenergan again and, about one hour before the operation, morphine and atropine. The dosages are adjusted according to age, weight, and condition of the patient. Induction is carried out with thiopental and a short-acting muscle relaxant of the succinylcholine-type is used to facilitate endoscopy, intubation, and bronchoscopic aspiration if required. Anaesthetic maintenance is effected with Fluothane-ether, administered and vaporized with nitrous oxide–oxygen (50/50) and, when required, muscle-relaxant drip (succinylcholine-type) is administered at 0.1 per cent or 0.2 per cent to obtain a "balanced anaesthesia." At the beginning and in resistant patients, anaesthesia was potentiated by combining Nisentil® and Lorfan® or Leritine® and Lorfan. However, in view of the analgesic potency of Fluothane-ether which is becoming more evident, we use less and less potentiation, and now it is only used for immediate premedication, intravenously, or for postoperative sedation in the recovery room.

Duration of Anaesthesia

In pulmonary surgery, it is well known that operations generally last much longer than in ordinary general surgery, resections lasting about three hours and sometimes more.

Anaesthetic Equipment

The anaesthetic machines generally used are two types: the Boyle's and the Heidbrink.

The Fluothane-ether mixture was first used in the ether bottle of the Boyle's machine in open or semi-open circle (10 patients), and also in the No. 7 vaporizer of the Heidbrink machine (2 patients) only in semi-open circle. A high flow, 6–8 L. of nitrous oxide and oxygen (50/50), was used for the vaporization of the volatile agents. We soon obtained a Fluotec vaporizer and we used it with the Boyle's machine for the majority of our cases (about 149). The Fluotec is an excellent vaporizer for Fluothane, its main advantage being the precision of vaporization. We shall talk about this subject later. The Vernitrol vaporizer of the new Heidbrink machine was also used in 80 cases. The Vernitrol system vaporizes the Fluothane-ether mixture at a high and uniform concentration. This concentration is, however, too high to be administered to the patient and, for this reason, with the help of a nomogram, we calculate the flow of nitrous oxide and oxygen necessary for the dilution of our volatile mixture. Finally, we were able to read on the Vernier scale the volume of gas administered to the patient, of Fluothane-ether as well as nitrous oxide–oxygen; (this is the reason for the name Vernitrol). When the quantity of nitrous oxide–oxygen is insufficient, the Vernitrol

vaporizer can deliver to the patient dangerous and even lethal concentrations of Fluothane-ether which is a serious disadvantage. Our clinical experience with the Fluothane vaporizers corroborates that of Drs. MacKay and Kalow of Toronto (4) who stated that: "The Fluotec possesses great precision and consequently this vaporizer presents greater safety and efficacy." Its compensating mechanism for the control of temperature and gas flow in the semi-open as well as open circle provides precision and gives excellent results. Moreover, for safe administration and a more precise Fluothane-ether vaporization, it is important to attach the vaporizer to the anaesthetic machine between the control valve and the circle inlet and not inside the circle itself. In doing this, the Fluothane-ether and the nitrous oxide–oxygen vapour always remain the same and do not vary with the patient's ventilation.

Cardiac and General Surgery

In addition to the above-mentioned pulmonary surgery cases, we also used the Fluothane-ether mixture in 19 cases of cardiac surgery (such as arterial shunts, coarctation of the aorta, pericardial cyst, and mitral commissurotomy), and in 152 cases of general surgery (such as arthrodesis, Albee's graft, appendectomy, cholecystectomy, incision of abscesses, tonsillectomy, nephrectomy, and in obstetrics).

Jefferson Respiratory Ventilator

In all patients, a total of 394, breathing was assisted by manual control or with the aid of the Jefferson ventilator, with or without negative pressure, as required.

Discussion, Results, and Conclusions

Discussion and Results

From the beginning, we have indicated the great satisfaction we obtained with the Fluothane-ether azeotropic mixture in pulmonary surgery especially for the following reasons: (i) safety of the azeotropic mixture from the cardiorespiratory aspect; (ii) the practical use of this anaesthetic method in pulmonary surgery.

From the respiratory viewpoint. A 1.5 per cent inhaled vapour concentration suffices to maintain anaesthesia. Consequently, in pulmonary surgery where one nearly always encounters some difficulty with oxygenation, the azeotropic mixture provides a more than satisfactory oxygen saturation. Moreover, the bronchodilator effect improves our patients' ventilation which is often reduced due to their respiratory disease. In this series of cases, no patient showed any serious anoxia or even hypoxia during surgery. In summarizing, let us say that with Fluothane-ether no respiratory difficulty occurs, whereas Fluothane alone reduces the respiratory minute rate. Postoperatively, atelectasis was reduced to a minimum.

From the cardiovascular viewpoint. Another safety feature of the Fluothane-ether mixture lies in the fact that, contrary to the use of Fluothane alone, it does

not seem to affect our patients' cardiovascular function, at least in light anaesthesia. This is our personal clinical experience and was proved in experiments on dogs. A hypotension of 20–30–40 mm. Hg was seen only in deep anaesthesia, which is not at all necessary in pulmonary surgery. Likewise, in light anaesthesia, arrhythmias seldom appear on the electrocardiogram and consist only of a few extrasystoles when they do. Our previous studies on dogs showed that the cardiac output is practically unaffected in light anaesthesia. In the same series there was absolutely no cardiovascular disturbance with the exception of a few extrasystoles on electrocardiogram and a slight hypotension of about 10 mm. Hg. As was emphasized by the authors of this method, the ether fraction which stimulates respiration and circulation makes the mixture twice as safe from the cardiorespiratory viewpoint.

Practicability of this anaesthetic method. The second reason for our satisfaction with the Fluothane-ether in anaesthesia for pulmonary surgery is its cardiorespiratory safety. The mixture can be administered in any pulmonary case with the possible exception of certain bronchial fistulas where inhalation anaesthesia is contraindicated because it would mean the induction of anaesthetic gases into an already perforated tube. Moreover, since Fluothane renders the mixture nonflammable, the use of the electric cautery or bistoury is facilitated, an undeniable advantage in pulmonary surgery. Consequently, this method is essentially practical.

Conclusion

After using the azeotropic Fluothane-ether mixture in anaesthesia for pulmonary surgery on patients of various ages, for different kinds of operations, with various anaesthetic machines and different techniques, we are extremely satisfied with the results and we believe we are justified in recommending this new anaesthetic technique for pulmonary surgery to our confrères.

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FLUOTHANE-ETHER EN ANESTHESIE POUR CHIRURGIE PULMONAIRE

J.-P. Dechêne, m.d., et Claude Hébert, m.d.[1]

Depuis le début de février 1958, le mélange azéotrope Fluothane-éther est employé couramment et avec grande satisfaction dans le Service d'Anesthésie de l'Hôpital Laval. Nous l'avons en effet utilisé à fin d'avril 1959 dans 241 cas différents de chirurgie pulmonaire, chez des patients de différents âges, à l'aide de différents appareils et après différentes modalités de technique. Ce bref exposé a pour unique but de vous faire part de notre expérience clinique avec le Fluothane-éther, spécialement en anesthésie pulmonaire, et de vous démontrer par la suite les nombreux avantages de cette méthode d'anesthésie, qui entre nos mains du moins contribue à diminuer le risque opératoire et anesthésique.

Considérations générales

Avant de vous faire part de notre expérience clinique avec le Fluothane-éther en anesthésie pour chirurgie pulmonaire, permettez-nous cependant de vous rappeler ces quelques considérations générales. Ce fait d'associer des anesthésiques volatiles entre eux est bien connu de tous et en particulier du médecin praticien. Les associations, chlorure d'éthyle-éther, Vinéthène-éther et surtout chloroforme-éther, bien qu'elles soient des associations imparfaites, sont demeurées encore dans la pratique médicale journalière. Toutefois dans les centres hospitaliers modernes, pourvus de plus en plus de spécialistes en la matière groupés dans un service d'anesthésie, des mélanges anesthésiques parfaits sont à la fois recherchés, désirés et désirables. C'est ainsi qu'a pris naissance, grâce au Professeur Fernando Hudon et à ses collaborateurs, le mélange anesthésique volatil parfait dit "mélange azéotrope Fluothane-éther," composé de 31.7 vol. pour cent d'éther et de 68.3 vol. pour cent de Fluothane; "solution d'anesthésique à point d'ébullition commun soit 51.5° C. et réalisant une action concomittante et non successive." Comme la plupart d'entre vous le savent, après avoir entendu ou lu plusieurs travaux sur le sujet, les résultats cliniques de ce nouveau mélange se sont avérés très intéressants en chirurgie générale. De l'avis même des auteurs, on obtient "une anesthésie améliorée qui laisse entrevoir une utilisation de plus en plus étendue de ce mélange." Or à l'Hôpital Laval, dans le but d'améliorer nos techniques en anesthésie pour chirurgie pulmonaire et cardiaque, a-t-on voulu utiliser ce mélange azéotrope et l'étudier davantage si possible. Aussi encouragés par les études cardio-vasculaires que nous avons faites chez le chien et stimulés par le succès de nos premiers essais cliniques en chirurgie pulmonaire, cette méthode moderne d'anesthésie est donc devenue une pratique journalière spécialement en chirurgie pulmonaire, sujet de la présente communication.

[1]Service d'anesthésie, Hôpital Laval.

Expérience clinique

Statistiques opératoires

Comme nous le disions au tout début de ce travail, le mélange azéotrope Fluothane-éther (1er février 1958 au 15 avril 1959) a été employé à l'Hôpital Laval dans 241 cas différents de chirurgie pulmonaire. Parmi ces différents cas, ce sont les segmentectomies (25 cas), les lobectomies (114 cas) et les pneumonectomies (53 cas) qui furent les interventions les plus nombreuses, soit un grand nombre total de 192 cas de résections pulmonaires. On compte de plus 18 cas de thoracoplasties, quelques cas (soit 31 en tout) de bronchographies, et bronchographies plus broncho-aspirations (13 cas), costectomies et drainages thoraciques (18 cas). L'âge des patients, dans toutes ces interventions, varie grandement soit de 2 à 69 ans; mais si l'on calcule la moyenne d'âge qui est de 27 ans, on s'aperçoit vite que la majorité de nos patients sont dans la vingtaine ou la trentaine.

Technique anesthésique

La prémédication, comme c'est l'habitude dans notre milieu, est plutôt forte et composée: la veille, d'un hypnotique non barbiturique Nodular® en association avec l'antihistaminique Phénergan®; le matin, également Phénergan suivi de morphine-atropine, environ une heure avant l'intervention. Il va sans dire que les doses de ces médicaments sont calculées selon l'âge, le poids et la résistance de l'individu. Quant à l'induction, elle est faite au Pentothal et un curare à action brève du type succinylcholine est utilisé pour faciliter les manœuvres endoscopiques: intubation et bronchoscopie aspiratrice si nécessaire auparavant. Ce maintien de l'anesthésie se fait par le Fluothane-éther véhiculé et vaporisé à l'aide de protoxide d'azote–oxygène (50/50) et lorsque nécessaire une perfusion curarisante (type succinylcholine) est administrée en goutte-à-goutte à 0.1 pour cent ou 2 pour cent, réalisant ainsi une anesthésie balancée. Au début, dans certains cas jugés résistants, l'anesthésie a été potentialisée par l'association Nisentil®-Lorfan® ou Léritine®-Lorfan; mais devant la puissance analgésique du Fluothane-éther qui s'affirme de plus en plus, nous employons de moins en moins cette potentialisation et cette médication ne sert aujourd'hui qu'en prémédication immédiate par voie intraveineuse ou en sédation post-opératoire dans la salle de réveil.

Durée de l'anesthésie

En anesthésie pulmonaire, il va sans dire que la durée moyenne des interventions est bien supérieure à celle que l'on rencontre ordinairement en chirurgie générale soit environ trois heures pour les résections et parfois plus.

Appareillage anesthésique

Ces appareils anesthésiques employés sont de deux types soit la machine anglaise Boyle, soit la machine américaine Heidbrink. Ce mélange de Fluothane-éther a d'abord été employé dans la bouteille à éther de la Boyle en circuit ouvert ou semi-fermé (10 cas); ainsi que dans le vaporisateur No 7 de la machine Heidbrink (2 cas) en circuit semi-fermé seulement. Un débit élevé (6–8 litres) de protoxide d'azote–oxygène (50/50) servait de véhicule pour la vaporisation des substances volatiles. Bientôt, nous avons fait l'acquisition du vaporisateur Fluotec

que nous avons employé avec la machine Boyle dans la majorité de nos cas soit 149. Ce Fluotec est un vaporisateur merveilleux du Fluothane dont le principal avantage réside dans la précision de la vaporisation. Nous en reparlerons un peu plus loin. Le vaporisateur Vernitrol de la nouvelle machine Heidbrink fut également utilisé pour 80 cas. Ce système de vaporisation Vernitrol vaporise le mélange Fluothane-éther à une concentration donnée haute et uniforme. Cette concentration, toutefois, est trop élevée pour être administrée telle quelle au patient, et c'est pourquoi à l'aide d'un monogramme, nous calculons le débit nécessaire de protoxide d'azote et d'oxygène pour diluer notre mélange volatile. Enfin, nous pouvons lire sur un vernier la quantité de gaz administré au patient tant en Fluothane-éther qu'en protoxide d'azote–oxygène de là nom de vaporisateur Vernitrol. Si la quantité de gaz diluant protoxide d'azote–oxygène est insuffisante, ce vaporisateur Vernitrol peut certainement délivrer au patient des concentrations dangereuses voire même léthales de Fluothane-éther. Ceci étant un désavantage sérieux. En effet notre expérience clinique avec les vaporisateurs de Fluothane confirme en tout point celle des Drs MacKay et Kalow de Toronto à savoir que le "Fluotec possède une grande précision et que par conséquent ce vaporisateur est plus sûr et plus efficace." Son système compensateur pour la température et la vitesse du courant gazeux aussi bien en circuit semi-fermé qu'en flot continu en circuit ouvert, permet cette grande précision et donne d'excellents résultats. Enfin, pour une administration sûre et une vaporisation plus précise de Fluothane-éther, il est important de toujours placer le vaporisateur sur la machine d'anesthésie entre les débits mètres et l'entrée du circuit et non pas dans le circuit lui-même; afin que la dilution du Fluothane-éther par les gaz diluants protoxide d'azote–oxygène soit toujours la même et non dépendante de la ventilation minute du patient variable avec chaque respiration.

Chirurgie cardiaque et générale

Disons aussi en passant que outre les cas de chirurgie pulmonaire ci-haut rapportés, nous avons utilisé le mélange Fluothane-éther également dans 19 cas de chirurgie cardiaque (voire canal artériel, coarctation de l'aorte, kyste péricardique et commissurotomie mitrale) et dans 152 cas de chirurgie générale (voire arthrodèse, greffe d'Albée, appendicectomie, cholécystectomie, ouverture d'abcès, amygdalectomie, néphrectomie, obstétrique).

Le respirateur Jefferson et son emploi électif

Enfin, pour tous les cas, dont nous venons de parler, soit un grand total de 394 cas, la respiration, si nécessaire, a été assistée ou contrôlée, soit manuellement, soit mécaniquement à l'aide du respirateur Jefferson et avec ou sans pression négative suivant le besoin.

Discussion, résultats et conclusions

Discussion et résultats

Dès le début de ce travail, nous avons laissé entrevoir notre grande satisfaction pour le mélange azéotrope Fluothane-éther en anesthésie pour chirurgie

pulmonaire et ceci pour plusieurs raisons dont les deux principales sont: (i) la sûreté du mélange azéotrope au point de vue cardio-respiratoire; (ii) le pratique de cette méthode d'anesthésie en chirurgie pulmonaire.

Au point de vue respiratoire. Une concentration de 1.5 pour cent en vapeurs inspirées suffit pour la maintenance de l'anesthésie. Ce mélange azéotrope permet donc une oxygénation plus que satisfaisante en chirurgie pulmonaire où l'on rencontre presque toujours des troubles d'oxygénation. De plus, son effet bronchodilatateur ne fait qu'améliorer la ventilation de nos patients si souvent diminuée à cause de leur pathologie respiratoire. En effet, dans la présente série de cas rapportés, aucun malade n'a présenté des troubles sérieux d'anoxémie voire même d'hypoxémie per-opératoire. Donc avec le Fluothane-éther pas le moindre incident respiratoire sérieux tandis qu'avec le Fluothane seul: diminution de l'air courant et de la ventilation/minute. Post-opératoirement, l'incidence atélectasique a été réduite au minimum.

Au point de vue cardio-vasculaire. Un autre facteur de sûreté et de sécurité du mélange Fluothane-éther c'est qu'à l'encontre du Fluothane seul, il ne semble pas toucher la fonction cardio-vasculaire de nos patients du moins en anesthésie légère et cela d'après notre propre expérience clinique à l'hôpital et expérimentale chez le chien au laboratoire de recherches. L'hypotension marquée de 20–30–40 mm. Hg n'a été vue qu'en anesthésie profonde et cette dernière n'est nullement nécessaire en chirurgie pulmonaire. De même en anesthésie légère l'arythmie est rare à l'électrocardiogramme et consiste seulement dans quelques rares extra-systoles. Enfin, chez les chiens, nos études antérieures démontrent très clairement que le débit cardiaque n'est à peu près pas touché en anesthésie légère. Dans la présente série de cas rapportés également, il n'y a eu absolument aucun incident cardio-vasculaire si ce n'est que quelques extra-systoles à l'E.C.G. et de légères hypotensions de l'ordre de 10 mm. Hg. Comme l'ont si bien dit les auteurs de la méthode, la fraction éther jouant à la fois un rôle stimulant sur la respiration et sur la circulation augmente ainsi d'autant la sécurité de la mixture et la sûreté de son emploi au strict point de vue cardio-vasculaire.

Le pratique de cette méthode d'anesthésie. La deuxième raison de notre grande satisfaction de l'emploi du Fluothane-éther en anesthésie pour chirurgie pulmonaire découle de la première. En effet, à cause de la sûreté cardio-respiratoire du mélange, il peut être administré et il est administrable dans tous les différents cas de chirurgie pulmonaire qui puissent se présenter; sauf peut-être dans certains cas de fistules bronchiques où l'anesthésie par inhalation elle-même est contre-indiquée, puisqu'on introduisait des gaz anesthésiques dans une tuyauterie percée à l'avance. De plus, le Fluothane rendant la mixture anesthésique non inflammable facilite l'emploi du cautère ou du bistouri électrique, ce qui est un avantage indéniable en chirurgie pulmonaire. Cette méthode d'anesthésie est donc essentiellement pratique.

Conclusion

En conclusion, après un emploi raisonnable du mélange azéotrope Fluothane-éther en anesthésie pulmonaire, chez des patients de différents âges, pour différentes interventions, à l'aide de différents appareils et après différentes modalités

de technique, nous sommes très satisfaits des résultats obtenus et nous croyons pouvoir recommander en toute sécurité cette nouvelle méthode d'anesthésie pour chirurgie pulmonaire aux confrères anesthésistes que la chose peut intéresser.

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THE ANTI-EMETIC ACTION OF FLUOTHANE: A COMPARATIVE STUDY IN OBSTETRICAL ANAESTHESIA

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ALTHOUGH MODERN OBSTETRIC TECHNIQUES have considerably reduced the cause of maternal deaths owing to infection, toxaemia, and haemorrhage, anaesthetic procedures during labour and delivery are still the cause of many fatalities according to recent statistics (1, 2).

Some of the most troublesome occurrences during obstetric anaesthesia are nausea, retching, and vomiting, of which vomiting can cause the most serious complications (3, 4). It is surprising how many publications have appeared on the subject of vomiting and its treatment during surgical and obstetric anaesthesia; but, to date, no drug, technique, or anaesthetic procedure has been found to prevent it.

The causes for the high incidence of vomiting during delivery are:

Anaesthesia

- O_2 deprivation
- CO_2 accumulation
- Length of procedure
- Operative site
- Troublesome induction
- Premedication

Anatomicophysiologic changes during pregnancy

- Fulness of abdominal cavity
- Compression and displacement of stomach
- C.N.S. irritability
- Alterations of the sympathetic and parasympathetic systems
- Endocrine changes
- Sudden onset of labour and rapid delivery with a full stomach

Emotional stress during delivery

- Fear of delivery, especially in primiparae
- Fear of the anaesthetic mask technique
- Abnormal behaviour of mothers who do not want the baby

These are some of the factors which lead to vomiting during anaesthetic procedures.

Although the literature on Fluothane® is extensive, we have seen few reports so far about its use in obstetrics. This is surprising in view of the large number of anaesthetic services which are now evaluating Fluothane clinically as a substitute for chloroform or other agents in obstetrics (Table I).

In this paper we are reporting our experiences in 250 unselected deliveries, from July, 1958, to July, 1959, comparing Fluothane with Trilene® and cyclopropane from the point of view of its anti-emetic properties.

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TABLE I

	No. of cases	Anaesthetic agents				Mortality		Delivery	
		Cyclopropane	Trilene	Fluothane	Others	Mother	Child	Normal	Forceps
1957	1541	130	964	0	447	0	44	1153	388
1958	1521	225	353	397	546	0	31	1238	283
1959*	759	55	53	478	173	0	23	596	163

*January to July, 1959.

At present, we have under way another extensive study using the azeotropic mixture recommended by Hudon (5) which we found also reduces the incidence of vomiting. We are hoping to assess the racial, emotional, constitutional, and nutritional factors which may cause vomiting during labour and delivery.

Technique

We have used the technique described below in all cases, with slight variations, depending on the nervous state of the patient, type of obstetric procedure, and whether the case was an emergency.

We have used the standard English Boyle's machine for all Fluothane anaesthesias with the Fluotec apparatus instead of the Trilene bottle, whereas for the other anaesthetic procedures we used the standard Ohio Heidbrink. The delivery of known concentrations is, of course, imperative to obtain good results with the use of this agent (6).

A transparent plastic mask is used so that the patient's mouth may be constantly observed for secretions, regurgitations, or silent vomiting. This is often difficult to observe during prolonged and severe uterine contractions. We use a semi-open circle, with a Leigh valve near the patient's head and the bag near the open circle valve. The patient's head is always tilted backward and laterally; no pillows are used. The delivery table is slightly in the Trendelenburg position. An aspiration machine with a rubber and metal sucker is placed near the anaesthetist.

The patient is instructed to breathe deeply and slowly with every painful contraction, and a mixture of nitrous oxide (5–6 L./min.) and oxygen (2 L./min.) is given intermittently at the end of the dilatation period. As soon as the perineum becomes prominent in primiparae, or the contractions severe and continuous in multiparae, Fluothane is added to the mixture (now 4 L./min. of nitrous oxide and 2 L./min. oxygen) in a concentration of 0.5 per cent for 1 min., then increased to 0.9 up to 1.3 per cent in an average case; when the patient is excited or in great pain, the Fluothane concentration may be increased from 1.7 to 2.3 per cent, which is maintained for 4 to 6 min. Afterwards anaesthesia is maintained with 0.6 to 0.9 per cent in the average patient.

When the baby's head emerges, Fluothane and nitrous oxide are stopped and a flow of 7 to 10 L./min. of oxygen is given until the umbilical cord is clamped. After this, the procedure is started again as described above, if necessary, for repair or manual curettage.

The patient wakens surprisingly quickly, is in most cases well oriented, and asks for the baby within a few minutes.

In the few cases where muscle relaxants are required, such as Brevidil or Anectine, Fluothane is reduced to 0.5 per cent while the anaesthetist controls respiration.

We always try to maintain the patient in the lightest anaesthetic plane possible, and if the contractions become less frequent, the concentration of Fluothane is decreased according to the requirements of the patient.

Results

This technique has been used in 250 unselected patients in labour, and we have compared our results in reducing vomiting with our previous experiences with cyclopropane and Trilene (Table III). Every time we returned to the use of these latter two agents, we came to the same conclusion, which was corroborated by other anaesthetists of our service. The decreased incidence of vomiting following Fluothane justifies the use of this anaesthetic agent routinely in all cases of obstetric anaesthesia (Table I).

Our evaluation of vomiting is as follows: *severe*: repeatedly during delivery and post-delivery; *medium*: during delivery only (two or three times); *mild*: a small amount during delivery only (once).

Nausea and retching are considered a separate symptom complex. Nurses are instructed to record any kind of vomiting, nausea, or retching before, during, and after delivery over a period of 12 hours.

TABLE II

	Anaesthetic agent		
	Cyclopropane	Trilene	Fluothane
Maternal mortality	0	0	0
Maternal morbidity	2	3	3
Foetal mortality	5	2	4
Foetal morbidity*	8	6	11

*We include in this section all babies who needed any kind of supplementary therapeutic measure after birth.

All patients were premedicated, by their private doctors or obstetric staff, mainly with Demerol (50–75 mg.) every 4 to 6 hours; we always try to avoid giving drugs at least 2 hours before expected delivery. A barbiturate, either pentobarbital or Secobarbital, is usually added in an average dose of 100 mg. every 4–6 hours. The longest procedure was 1 hour, 45 min., and the shortest 15 min.

In our series we had seven cases of vomiting in spite of Fluothane. In three of these we do not believe that Fluothane was the cause. The first woman was delivered of a six-month-old dead foetus, Rh negative. The second woman was

admitted with the knowledge that the baby was dead; she was upset, nervous, and crying. The third case was a woman who had emotional and moral problems concerning her pregnancy, and she vomited during induction.

The effect of Fluothane in reducing vomiting compared to Trilene and cyclopropane as shown in Table III is evident. Although our series is small, our results correspond to those obtained by other authors who have used Fluothane in obstetrics (7, 8) and in other fields of surgery (9, 10, 11).

TABLE III

Anaesthetic agent	No. of cases	Vomiting			Retching and nausea	Vomiting (%)
		Severe	Medium	Mild		
N_2O and C_3H_6	50	0	4	17	13	42.0
N_2O and Trilene	50	0	1	13	10	28.0
N_2O and Fluothane	150	0	3	4	8	4.6
TOTALS	250	0	8	34	31	16.8

We have not seen any serious complications in our series which could be attributed to Fluothane (Table II) and no other therapeutic measures had to be carried out in any patient. One woman had a fall in blood pressure after long labour and uterine haemorrhage which required manual curettage and extraction of the placenta, but she was well controlled with blood transfusions and was awake at the end of the procedure without evidence of vomiting or excitation. Fluothane was not discontinued in this case.

We had no complaints from the obstetricians regarding uterine relaxation or bleeding, and they were satisfied with our technique. From the point of view of the baby, as shown in Table II, Fluothane appears to be safe and certainly not more dangerous than other agents. We have not seen any apnoea or depression of clinical significance. The patients were able to take fluids after 2–4 hours post partum, were wide awake and quiet, and few had to forego their regular meals.

TABLE IV

Operation time	No. of cases	Vomiting			Retching and nausea	Vomiting (%)
		Severe	Medium	Mild		
Up to 15 min.	46	0	3	11	13	30.4
15 to 30 mins.	81	0	2	8	5	12.3
30 mins. to 1 hr.	94	0	0	9	9	9.5
More than 1 hr.	29	0	3	6	4	31.0
TOTALS	250	0	8	34	31	16.8

As shown in Table IV, vomiting seems to occur more frequently during long procedures and when rapid induction is required. In our experience, however, when Fluothane is used in the manner described above (Tables V, VI), its antiemetic action was also shown during long procedures and when different operating techniques were employed.

TABLE V

FLUOTHANE ANAESTHESIA

Type of procedure	No. of cases	Vomiting			Retching and nausea	Vomiting (%)
		Severe	Medium	Mild		
Normal delivery	73	0	1	2	4	4.1
Normal delivery and repair	32	0	2	1	2	9.3
Forceps and repair	45	0	0	1	2	2.2
TOTALS	150	0	3	4	8	4.6

TABLE VI

ALL ANAESTHESIA

Type of procedure	No. of cases	Vomiting			Retching and nausea	Vomiting (%)
		Severe	Medium	Mild		
Normal delivery	123	0	3	25	14	22.7
Normal delivery and repair	55	0	4	12	7	29.0
Forceps and repair	72	0	1	7	10	11.1
TOTALS	250	0	8	44	31	20.8

COMMENTS

We consider the use of Fluothane indicated in obstetrics to reduce vomiting during labour. Because of its favourable effect on this condition, we regard Fluothane the agent of choice for the following reasons:

1. It is safe for mother and child.
2. Its action is rapid. Fluothane acts faster than the anaesthetic agents commonly used in obstetrics.
3. It controls the principal sensory and vomiting reflexes.
4. Induction is smooth due to its rapid action. In over-excited women, induction and awakening are pleasant and conditions giving rise to vomiting are eliminated.
5. Fluothane suppresses the vomiting centre in contrast to other anaesthetic agents, such as ether.
6. In this series no mucous membrane irritation of the respiratory and digestive tracts were seen, irrespective of anaesthetic concentration.
7. It has no stimulating action on the secretory glands of the respiratory and digestive tracts. No undue salivary, mucous, or gastric secretions were noted.
8. Pharyngolaryngeal reflexes are rapidly obtunded and, if necessary, an airway can be introduced easily.
9. It counteracts the vomiting-inducing effects of some premedicative drugs, such as morphine and Demerol®.
10. Because of the potency of Fluothane, a high concentration of oxygen can be added, thus avoiding anoxic vomiting.

11. Its rapid elimination brings quick recovery even after prolonged operations, producing less nausea and retching. Patients experience no gastric discomfort as caused by other agents and no routine anti-emetic medication has to be given. If present, it is so negligible that no therapy is required.

12. The organoleptic characteristics of Fluothane are well within the tolerance margin of normal persons.

13. As Fluothane is eliminated unchanged through the lung, no metabolic changes occur during the complicated metabolic process of labour.

14. Patients who have been induced during states of excitement, crying or fighting because of fear, generally awake calmed, happy, and in good physical condition.

15. As Fluothane does not appear to be a vagal stimulant, coughing and other reflexes which may induce vomiting are not stimulated.

Among the disadvantages of Fluothane anaesthesia in obstetrics are:

1. Trained, skilful anaesthetists are needed.
2. A special vaporizer is needed.
3. It is expensive for general use.
4. It has a reported depressant action on the respiratory and circulatory systems. (Patients coming to the delivery room are usually healthy and rarely have any cardiac or respiratory complications.)

It must be emphasized that Fluothane and the technique attending its use are recommended for trained personnel. Blood pressure, pulse, heart rate, and rhythm must be frequently checked, especially in the delivery room where confusion often exists owing to emergencies and the tense atmosphere inevitable during delivery. Fluothane is a very potent agent and the use of a calibrated vaporizer and constant observations are obligatory.

Summary

This paper presents a comparison between the anti-emetic properties of Fluothane, Trilene, and cyclopropane during obstetrical anaesthesia in 250 unselected deliveries.

A marked reduction in the incidence of vomiting during obstetrical anaesthesia has been obtained with the use of controlled concentrations of Fluothane (Fluotec apparatus) and a low percentage of this agent. The advantages and disadvantages of Fluothane in obstetrical anaesthesia are enumerated and the tabulated results are self-evident.

Acknowledgment

I should like to acknowledge the help of Dr. Leighton Smith, Medical Director of Ayerst, McKenna & Harrison, in correcting the English translation of this paper.

Résumé

Dans ce travail, nous comparons les propriétés anti-émétiques de Fluothane, de Trilène et du cyclopropane dans 250 cas d'accouchements non sélectionnés,

au point de vue de la diminution de l'incidence de vômissements par l'emploi de Fluothane.

Les résultats obtenus dépendent de l'administration adéquate de Fluothane, du matériel et de la technique employés. Une basse concentration de Fluothane et l'emploi d'un appareil Fluotec sont, de façon marquée, les principales causes des résultats qui s'obtiennent.

Les avantages et désavantages de l'anesthésie au Fluothane en obstétrique et les résultats énumérés aux tableaux de cet ouvrage sont suffisamment éloquents.

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POSTOPERATIVE NAUSEA AND VOMITING: THE RESPONSE TO ANTI-EMETIC DRUGS WITH SPECIAL REFERENCE TO CYCLIZINE AND PERPHENAZINE

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OVER THE PAST TWO to three decades, advances in surgery have stimulated parallel advances in anaesthesia. In fact, it can be said that so many of the intricate surgical procedures would be impossible without the support of skilled anaesthetic techniques. An indication of the satisfactory progress of anaesthesia is the patient's expectation of a pleasant smooth induction and an uneventful recovery. There is no doubt that anaesthesia has attained its high standard by reason of scientific and clinical research carried out by anaesthetists and pharmacologists. However, in spite of refinements of preoperative sedation, anaesthetic technique, and careful supervision in the immediate postoperative period, the incidence of nausea and vomiting is still too high. As observed by Marcus and Sheehan (1), such complications only become highlighted when a recovery room is maintained and patients are seen together in the early postoperative period. Consequently the search for the satisfactory anti-emetic continues, and those which have been used with considerable success for travel sickness have been employed to reduce the occurrence of vomiting after operation. The anti-emetics in general use today tend to fall into two categories: (i) antihistamine compounds, for example, dimenhydrinate, cyclizine; (ii) tranquillizers, for example, chlorpromazine, promethazine, perphenazine, promazine.

It is of paramount importance that the many factors contributing towards postoperative vomiting should be appreciated, and attempts made to correct them before mere blind administration of palliative drugs is undertaken. Best and Taylor (2) maintain that the induction of vomiting can be due to such factors as:

(*a*) A reflex action arising from impulses from the stomach or other parts of the alimentary tract, extending from the pharynx downwards (irritation from blood, mucus, and irritant anaesthetic drugs entering the stomach itself will provide the necessary stimulus for vomiting)

(*b*) Central stimulation due to drugs which raise the excitability of the vomiting centre itself, for example, morphine and meperidine

Other causes of vomiting are discussed by Dent *et al.* (3). Impulses received from the cerebral centres in response to various stimuli, for example, rough handling of the patient during transfer from operating table to trolley and frequent changing of position during the early postoperative period, can be a factor in vomiting. Vestibular stimulation by morphine or anaesthetic drugs can increase the liability to vomiting. Best and Taylor consider that any interference with the blood supply to the vomiting centre either by haemorrhage or by tumour will

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stimulate vomiting. Anoxia is thought to be a very important source of stimulation, and any severe degree of anoxia has the same effect as impairment of blood supply. General disorders such as mental stress, hysteria or even fatigue can be the cause of postoperative vomiting, and it is conceded that the nervous, anxious patient is more likely to experience an unhappy recovery than the placid patient.

In an attempt to evaluate some of the anti-emetic drugs in postoperative vomiting a survey was undertaken. The *modus operandi* was as follows:

Two general surgeons and two gynaecologists gave permission for their patients to receive the anti-emetic drugs under consideration, and the remainder of the surgical cases were observed as controls. The patients constituting the control group did not receive any of the anti-emetic drugs during the whole operative period including preoperative and immediate postoperative periods. Each group contained a similar cross-section of types of operations, and a similarity in anaesthetic techniques was maintained since all anaesthetists worked in each group. In all, 1,403 patients (1,389 females, 14 males) were observed in the recovery room and in the ward on subsequent days up to the fifth day. The ages of the patients observed ranged from 5 years to 85 years, with the majority in the middle range. Detailed records were kept on each patient. The main scrutiny concerning nausea and vomiting was made over the first 36 hours after operation since it was felt that many other extraneous factors cause or accentuate the gastric disturbance after that time. Some observers in this field confine themselves to the first 12 hours at most, as they think that with modern anaesthesia the effects of the drugs should be eliminated by that time.

Only a brief résumé of the drugs used in this survey is presented since all of them have been well described in the literature.

1. Chlorpromazine is a derivative of phenothiazine and by reason of its neuroplegic action on the peripheral and central autonomic nervous system, it exhibits sedative and anti-emetic qualities, and also has the power to potentiate the activity of anaesthetic, analgesic and hypnotic drugs.
2. Promethazine, also a derivative of phenothiazine, has been shown to have antihistamine properties. It is also an anti-emetic and like chlorpromazine possesses potentiating properties.
3. Perphenazine has similar qualities and is an amino derivative of chlorphenothiazine. Animal studies indicate that perphenazine is five to ten times as potent as chlorpromazine but only half as toxic.
4. Cyclizine hydrochloride is an antihistamine and anticholinergic, and investigations indicate that it has a specific action on the parasympathetic ganglia.

Mode of Administration of Drugs

Cyclizine hydrochloride was administered in three ways:

(*a*) In the recovery room—by suppositories 100 mg. or 50 mg. intramuscularly if the operation involved the rectum or anus.

(*b*) Preoperatively with atropine and meperidine or pantopon. Because of the potentiating action of the cyclizine, it was found necessary to halve the amount of narcotic given. Therefore, the preoperative sedation was meperidine 50.0 mg., atropine 0.6 mg., cyclizine 50.0 mg. intramuscularly.

(*c*) Preoperative sedation as in (*b*) and supported by the administration of meperidine-promethazine-chlorpromazine or by meperidine-perphenazine during anaesthesia.

Meperidine-promethazine-chlorpromazine sequence was used in association with anaesthesia. The formula contained: meperidine 100 mg., promethazine 50 mg., chlorpromazine 50 mg., in 20 ml. of normal saline. The amount used during anaesthetic varied from 4 to 10 ml., depending on the length and type of operation.

Meperidine-perphenazine was administered in the same way as the meperidine-promethazine-chlorpromazine combination. The amounts contained in the solution: meperidine 100 mg., perphenazine 50 mg., in 20 ml. of normal saline.

Results

The material in the survey presents a variety of surgical procedures, and since the observations of some workers indicate that the site of operation has an influence on the incidence of postoperative vomiting, it was deemed necessary to compare the distribution of operations in the control group and in the treated patients. Table I presents the variety of major operations in each group. There is some degree of imbalance in the distribution between the two groups, but it is felt that it is due, mainly, to the small number of major orthopaedic operations, and consequently the groups are considered comparable.

TABLE I

The Distribution of the Types of Major Operations in the Control and Treated Groups

	Operations								
	Breast	Head and neck	Gastro-intes-tinal	Cholecyst-ectomies	Pelvic and other abdomi-nal	Fothergill repairs vaginal hysterec-tomies	Hernia repairs	Major ortho-paedic	Total
Control group									
Observed values	16.00	15.00	37.00	28.00	126.00	26.00	11.00	7.00	266.00
Expected values	21.26	10.33	28.64	35.43	125.77	27.75	13.28	3.54	266.00
χ^2	1.30	2.11	2.44	1.56	.00	.11	.39	3.38	11.29
Treated group									
Observed values	56.00	20.00	60.00	92.00	300.00	68.00	34.00	5.00	635.00
Expected values	50.74	24.67	68.36	84.57	300.23	66.25	31.72	8.46	635.00
χ^2	.55	.88	1.02	.65	.00	.05	.52	1.42	5.09
Total	72.00	35.00	97.00	120.00	426.00	94.00	45.00	12.00	901.00
									16.38

$\chi^2 = 16.38$. 7 df. $P < 0.05$.

During the course of the observations a variety of anaesthetic techniques was employed, and to estimate the effect, if any, of the main types of anaesthesia on the incidence of postoperative vomiting, Table II was constructed. The three anaesthetics presented were given in conjunction with thiopentone, and where

TABLE II

THE EFFECT OF DIFFERENT ANAESTHETICS ON THE POSTOPERATIVE VOMITING: MAJOR OPERATIONS

	Nitrous oxide	Volatile anaesthetic	Cyclopropane	Total
Absence of vomiting				
Observed values	266.00	195.00	65.00	526.00
Expected values	238.19	209.00	78.81	526.00
χ^2	3.25	.94	2.42	6.61
One episode of vomiting				
Observed values	77.00	91.00	43.00	211.00
Expected values	95.55	83.84	31.61	211.00
χ^2	3.60	.61	4.10	8.31
More than one episode of vomiting				
Observed values	65.00	72.00	27.00	164.00
Expected values	74.26	65.16	24.58	164.00
χ^2	1.15	.72	.24	2.11
TOTAL	408.00	358.00	135.00	901.00
				17.03

$\chi^2 = 17.03$. 4 df. $P < 0.01$.

necessary, relaxant drugs were used. There is a significant increase in the amount of postoperative vomiting in the patients receiving a volatile anaesthetic, and also in the cyclopropane group. In the latter patients the increase appears to be more confined to one episode of vomiting. Since it is felt that the type of anaesthetic does influence the results in this series, a study of the distribution of the types of anaesthetics used in each group of anti-emetic treatment is presented. Table III shows this distribution, and it is seen that the patients in the control group received more volatile anaesthetics and cyclopropane than those given anti-emetics. A further analysis was made of each anti-emetic group and also of the controls. In every such group the incidence of vomiting was studied in relation to the type of anaesthetic used; but it was found that none of the tables produced significant

TABLE III

THE DISTRIBUTION OF TYPES OF GENERAL ANAESTHESIA IN RELATION TO ANTI-EMETIC DRUGS: MAJOR OPERATIONS

	Nitrous oxide	Volatile anaesthetic	Cyclopropane	Total
Controls				
Observed values	82.00	132.00	52.00	266.00
Expected values	120.45	105.69	29.86	266.00
χ^2	12.27	6.55	3.70	22.52
Meperidine and tranquillizer				
Observed values	140.00	100.00	27.00	267.00
Expected values	120.91	106.09	40.00	267.00
χ^2	3.01	.35	4.23	7.59
Combined cyclizine groups				
Observed values	186.00	126.00	56.00	368.00
Expected values	166.64	146.22	55.14	368.00
χ^2	2.25	2.80	.01	5.06
TOTAL	408.00	358.00	135.00	901.00
				35.17

$\chi^2 = 35.17$. 4 df. $P < 0.001$.

TABLE IV

AN ANALYSIS OF PATIENTS RECEIVING NITROUS OXIDE SUPPORTED BY THIOPENTONE, WITH OR WITHOUT RELAXANT DRUG: MAJOR OPERATIONS

	Absence of vomiting	One episode of vomiting	More than one episode	Total
Controls				
Observed values	36.00	23.00	23.00	82.00
Expected values	53.26	15.68	13.06	82.00
χ^2	5.59	3.42	7.56	16.57
Meperidine-tranquillizer sequences				
Observed values	99.00	30.00	11.00	140.00
Expected values	90.94	26.76	22.30	140.00
χ^2	.71	.39	5.73	6.83
Cyclizine				
Observed values	130.00	25.00	31.00	186.00
Expected values	120.81	35.56	29.63	186.00
χ^2	.70	3.14	.06	3.90
TOTAL	265.00	78.00	65.00	408.00
				27.30

$\chi^2 = 27.30$. 4 df. $P < 0.01$.

results. This appeared to indicate a fairly steady action on the part of the individual anti-emetics whatever anaesthetic was employed. However, an analysis of the individual anaesthetic groups (Tables IV and V) points to the significant effect of meperidine-tranquillizer administrations. The numbers in Table VI are rather too small to be effective.

Table VII analyses the postoperative vomiting after major operations in the control group and the meperidine-tranquillizer series. The effect of the latter is significant. Patients receiving cyclizine are presented in three groups in Table VIII which shows the most satisfactory results are obtained when the cyclizine is supported by meperidine and tranquillizer. Comparisons of the main groups

TABLE V

THE INCIDENCE OF POSTOPERATIVE VOMITING AFTER THE USE OF VOLATILE ANAESTHETICS: MAJOR OPERATIONS

	Absence of vomiting	One episode of vomiting	More than one episode	Total
Controls				
Observed values	57.00	29.00	46.00	132.00
Expected values	71.90	33.55	26.55	132.00
χ^2	3.09	.62	14.25	17.96
Meperidine-tranquillizer sequences				
Observed values	69.00	29.00	2.00	100.00
Expected values	54.47	25.42	20.11	100.00
χ^2	3.88	.50	16.31	20.69
Cyclizine				
Observed values	69.00	33.00	24.00	126.00
Expected values	68.63	32.03	25.34	126.00
χ^2	.00	.03	.07	.10
TOTAL	195.00	91.00	72.00	358.00
				38.75

$\chi^2 = 38.75$. 4 df. $P < 0.001$.

TABLE VI

AN ANALYSIS OF THE EFFECT OF CYCLOPROPANE ANAESTHESIA: MAJOR OPERATIONS

	Absence of vomiting	One episode of vomiting	More than one episode	Total
Controls				
Observed values	22.00	18.00	12.00	52.00
Expected values	25.42	16.18	10.40	52.00
χ^2	.46	.20	.25	.91
Meperidine-tranquillizer sequences				
Observed values	19.00	8.00	.00	27.00
Expected values	13.20	8.40	5.40	27.00
χ^2	2.55	.02	5.40	7.97
Cyclizine				
Observed values	25.00	16.00	15.00	56.00
Expected values	27.38	17.42	11.20	56.00
χ^2	.21	.12	1.29	1.62
TOTAL	66.00	42.00	27.00	135.00
				10.50

$\chi^2 = 10.50$. 4 df. $P < 0.05$.

(Tables IX and X) show highly significant results in favour of the meperidine-tranquillizer treatment. Similar analyses of the 760 minor operation cases did not give any significant results, and this may have been due to the fact that very few patients received the meperidine-tranquillizer treatment.

Observations were made on 401 patients who experienced postoperative vomiting. Type of operation, anaesthetic received, and any prophylactic treatment given preoperatively or during operation were not taken into consideration. The anti-emetic given for the treatment of the vomiting was left to the discretion of the surgeon concerned. The drugs used were cyclizine and dimenhydrinate and

TABLE VII

THE RELATION BETWEEN POSTOPERATIVE VOMITING AND THE TYPE OF ANTI-EMETIC ADMINISTERED DURING ANAESTHESIA FOR MAJOR OPERATIONS

	Absence of vomiting	One episode of vomiting	More than one episode	Total
Control group				
Observed values	115.00	70.00	81.00	266.00
Expected values	150.70	68.40	46.90	266.00
χ^2	8.46	.04	24.80	33.30
Meperidine-promethazine-chlorpromazine during anaesthesia				
Observed values	103.00	45.00	7.00	155.00
Expected values	87.80	39.80	27.40	155.00
χ^2	2.63	.68	15.09	18.40
Meperidine-perphenazine during anaesthesia				
Observed values	84.00	22.00	6.00	112.00
Expected values	63.50	28.80	19.70	112.00
χ^2	6.69	1.61	9.62	17.92
TOTAL	302.00	137.00	94.00	533.00
				69.62

$\chi^2 = 69.62$. 4 df. $P < 0.001$.

TABLE VIII

THE INCIDENCE OF POSTOPERATIVE VOMITING IN THE CYCLIZINE SERIES: MAJOR OPERATIONS

	Absence of vomiting	One episode of vomiting	More than one episode	Total
Cyclizine given in recovery room				
Observed values	31.00	18.00	22.00	71.00
Expected values	43.22	14.28	13.50	71.00
χ^2	3.46	.97	5.35	9.78
Cyclizine given preoperatively				
Observed values	72.00	37.00	37.00	146.00
Expected values	88.87	29.36	27.77	166.00
χ^2	3.20	1.99	3.07	8.26
Cyclizine given preoperatively, supported by meperidine-tranquillizer sequences				
Observed values	121.00	19.00	11.00	151.00
Expected values	91.91	30.26	28.73	151.00
χ^2	9.21	4.25	10.94	24.40
TOTAL	224.00	74.00	70.00	368.00
				42.44

$\chi^2 = 42.44$. 4 df. $P < 0.001$.

observations were made after the administration of a maximum of two doses at 4-hour intervals within 36 hours after operation. A number of patients received no treatment for vomiting within the same period of time, and have been recorded as controls. Table XI compares the observations made on the three groups. Cyclizine presents the most satisfactory results and there is a significant reduction in vomiting following its administration. Dimenhydrinate produces little effect, if any at all, on the incidence of vomiting.

TABLE IX

RESULTS OF THE MEPERIDINE-TRANQUILLIZER SEQUENCES AND CYCLIZINE ADMINISTRATIONS: MAJOR OPERATIONS

	Absence of vomiting	One episode of vomiting	More than one episode	Total
Controls				
Observed values	115.00	70.00	81.00	266.00
Expected values	155.00	62.29	48.42	266.00
χ^2	10.45	.95	21.92	33.32
Combined meperidine-tranquillizer sequences				
Observed values	187.00	67.00	13.00	267.00
Expected values	155.87	62.53	48.60	267.00
χ^2	6.22	.32	26.08	32.62
Combined cyclizine administrations				
Observed values	224.00	74.00	70.00	368.00
Expected values	214.84	86.18	66.98	368.00
χ^2	.39	1.72	.14	2.25
TOTAL	526.00	211.00	164.00	901.00
				68.19

$\chi^2 = 68.19$. 4 df. $P < 0.001$.

TABLE X

RESULTS WITH PATIENTS RECEIVING BOTH CYCLIZINE AND THE MEPERIDINE-TRANQUILLIZER SEQUENCE ELIMINATED FROM THE CYCLIZINE GROUP: MAJOR OPERATIONS

	Absence of vomiting	One episode of vomiting	More than one episode	Total
Controls				
Observed values	115.00	70.00	81.00	266.00
Expected values	143.64	68.10	54.26	266.00
χ^2	5.71	.05	13.18	18.94
Combined meperidine-tranquillizer sequences				
Observed values	187.00	67.00	13.00	267.00
Expected values	144.18	68.35	54.47	267.00
χ^2	12.72	.03	31.57	44.32
Cyclizine (*a*) preoperatively; (*b*) in the recovery room				
Observed values	103.00	55.00	59.00	217.00
Expected values	117.18	55.55	44.27	217.00
χ^2	1.72	.00	4.90	6.62
TOTAL	405.00	192.00	153.00	750.00
				69.88

$\chi^2 = 69.88$. 4 df. $P < 0.001$.

DISCUSSION

The structural formulae of the phenothiazine derivatives show a close relationship, but this likeness is not always borne out in their pharmacological actions. They do possess, however, certain common properties, and the anti-emetic action is common to most of them. The two sequences employed in this investigation, that is, meperidine-promethazine-chlorpromazine and meperidine-perphenazine, do present a very definite improvement in the incidence of postoperative vomiting. The improvement may be due to two things: (*a*) the central action of the tranquillizers preventing vomiting; (*b*) the potentiation of anaesthetic agents, thus reducing the amount of potential nauseants used, as shown in Table III.

TABLE XI

RESPONSE TO THREE METHODS OF APPROACH TO POSTOPERATIVE VOMITING

	Cessation of vomiting	Continued vomiting	Total
Cyclizine postoperatively			
Observed values	137.00	62.00	199.00
Expected values	120.59	78.41	199.00
χ^2	2.23	3.43	5.66
Dimenhydrinate postoperatively			
Observed values	46.00	42.00	88.00
Expected values	53.33	34.67	88.00
χ^2	1.01	1.55	2.56
No treatment given			
Observed values	60.00	54.00	114.00
Expected values	69.08	44.92	114.00
	1.19	1.84	3.03
TOTAL	243.00	158.00	401.00
			11.25

$\chi^2 = 11.25$. 3 df. $P < 0.01$.

The meperidine-perphenazine combination superseded the meperidine-promethazine-chlorpromazine sequence in this survey since it was found that the former provided a very smooth recovery period, and that its administration during anaesthesia did not produce the hypotension created by meperidine-promethazine-chlorpromazine. So far, perphenazine has not been found guilty of causing liver damage or agranulocytosis, but reported Parkinson-like reactions to oral perphenazine have indicated its ability to cause extra-pyramidal dysfunction. Robbie (4) describes two patients exhibiting such dysfunction after multiple doses of intramuscular injections of perphenazine. The tranquillizers present a fascinating and complex study to anaesthetists, and in using them for a specific purpose one must be fully aware of their other properties. According to Hiebel *et al.* (5) both chlorpromazine and promethazine have the unique property of depressing the arousal mechanism of the reticular activating system without affecting the cortical regions, and since areas in the reticular system are responsible for the control of muscle tone, vasomotor tone (Back (6)), respiratory activity, and the act of vomiting (Borison *et al.* (7)), the results of such depression need careful consideration.

The preoperative cyclizine administrations do not present any significant relief in the incidence of postoperative vomiting. As far as this survey is concerned, it is thought that in some of the cases receiving cyclizine preoperatively, a delay in starting the operation and a prolonged operating time could have impaired the action of the anti-emetic drug in the recovery period. Under such circumstances a second intramuscular injection of cyclizine at the termination of the operation, or in the recovery room, might have prolonged its effectiveness. Observations by Chinn *et al.* (8) on certain antihistamine drugs lead them to think that prophylaxis does not depend on the antihistamine action of these drugs, but on the cholinergic effect. This would explain the effectiveness of drugs with a central atropine-like action, for example, scopolamine. Marcus and Sheehan (9) maintain that cyclizine given prophylactically is more effective than later administration once vomiting has occurred; however, in this series the effect of cyclizine is significant when used postoperatively for the treatment of vomiting. There were not any untoward side-effects observed in the patients treated with cyclizine.

Summary

A study of 1,403 patients has been conducted in relation to the efficiency of certain anti-emetic drugs used before and during operation. The drugs included in the survey were cyclizine and the meperidine-perphenazine, meperidine-promethazine-chlorpromazine sequences. A control group was established in which the patients did not receive any anti-emetic drugs before or during anaesthesia. The distribution of types of major operations and of anaesthetics given in the treated and control groups were compared.

The groups, established apart from the controls, were: (*a*) meperidine-promethazine-chlorpromazine during operation; (*b*) meperidine-perphenazine also during operation; (*c*) cyclizine suppositories 100 mg. in the recovery room; (*d*) cyclizine 50 mg. intramuscularly with the preoperative sedation; (*e*) cyclizine

50 mg. preoperatively supported by one of the aforementioned meperidine sequences during anaesthesia. The results indicate that cyclizine does not improve the postoperative vomiting to any significant degree, whereas the meperidine tranquillizer sequences show a significant decrease in the incidence of vomiting. A study of the postoperative treatment of 401 patients who vomited within 36 hours of operation indicated that intramuscular administrations of cyclizine produced significant improvement.

Acknowledgments

The author wishes to thank the surgeons for their kind co-operation during this study, and also the other members of the Anaesthetic Department for their conscientious assistance throughout. The excellent and detailed records were kept by Miss Robins, Research Assistant to the Anaesthetic Department. Mrs. Harms administered the cyclizine in the Recovery Room. I wish to thank the Board of Governors of the Hospital for their interest, and for the Fellowship Grants to Miss Robins and myself. I am very indebted to Dr. Werner Kalow of the Department of Pharmacology, University of Toronto, for his help and advice on the statistical analyses. I express my gratitude to Burroughs Wellcome and Company for their very practical assistance.

Résumé

Nous avons fait une étude chez 1,403 malades sur l'efficacité de certains médicaments employés comme anti-émétiques avant et durant les opérations. Les médicaments étudiés étaient la cyclizine et la mépéridine-perphenazine, mépéridine-promethazine-chlorpromazine dans l'ordre. Nous avions un groupe de témoins où les malades n'ont reçu aucun médicament anti-émétique ni avant, ni durant l'anesthésie. Nous avons comparé, chez les deux groupes, le partage des types d'opérations majeures et des anesthésiques donnés.

Le partage des groupes, en-dehors des témoins, étaient comme suit: (*a*) mépéridine-promethazine-chlorpromazine durant l'opération; (b) mépéridine-perphenazine également durant l'opération; (*c*) cyclizine 100 mg. en suppositoires à la salle de réveil; (*d*) cyclizine 50 mg. I.M. avec la sédation préopératoire; (*e*) cyclizine 50 mg. avant l'operation suivie, au cours de l'anesthésie, d'une des associations à la mépéridine mentionnées antérieurement. Les résultats nous démontrent que la cyclizine n'améliore pas de façon appréciable les vomissements post-opératoires, tandis que l'association mépéridine-tranquillisant a donné une diminution notable de la fréquence des vomissements. Une étude de 401 malades qui ont vomi durant les 36 heures suivant l'opération nous a prouvé que la cyclizine, en injections intramusculaires, a apporté une amélioration notable.

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FURTHER COMPARATIVE STUDIES OF SODIUM METHOHEXITAL[1]

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SODIUM METHOHEXITAL (Lilly 25398) has been the subject of a number of studies to evaluate its suitability for clinical anaesthesia (1–5). The drug is an oxybarbiturate, a fact which distinguishes it from all other commercially available ultra-short-acting barbiturates, with the exception of hexobarbital. Its chemistry and pharmacology have been described in a previous report (4).

In an earlier comparative study with sodium thiopental (4), each drug was used on a series of healthy women undergoing D & C. Either barbiturate was used for induction and maintenance of anaesthesia, oxygen only being administered by mask. On the basis of that study we came to the conclusion that methohexital, compared with thiopental, combined shorter action with greater potency. The relative potency of thiopental to methohexital was found to be 1:1.54 with a total sleep time ratio of 1:0.7. It was also found that induction with methohexital was slower which might lead to overdose until sufficient experience in the use of this drug has been gained. Apnoea following induction was less frequent with methohexital but was more prolonged when it did occur. While it was easy to maintain smooth anaesthesia by the intermittent administration of 2.5 per cent thiopental, the very short action and abrupt end point of methohexital made this mode of administration less practical. Induction with a 1 per cent methohexital solution followed by an 0.2 per cent intravenous drip was found more suitable. Untoward manifestations during anaesthesia such as hiccough were not particularly disturbing with methohexital and the incidence of undesirable emergence and recovery phenomena was no higher than with thiopental. After conclusion of anaesthesia, patients were more alert and less disorientated after methohexital. Neither methohexital nor sodium thiopental afforded consistently satisfactory relaxation for bimanual pelvic examination.

Having obtained these results it seemed advisable to carry out a further comparative study which might approximate more closely the actual clinical use of both drugs. Thiopental or methohexital was to be used for induction and thereafter in intermittent doses for supplementation of nitrous oxide anaesthesia, if and when required. This is a more desirable way of using barbiturates in anaesthesia; therefore, it would be interesting to know how methohexital compares with thiopental when used in this fashion. In order to eliminate any possible prejudices because of our previous studies and their findings, a blind study was decided upon.

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Supplies of Methohexital were made available through the courtesy of Eli Lilly and Company Limited, Indianapolis, Ind.

Method

As in the previous investigation, this series too was restricted to minor gynaecological procedures, using only patients in physical status 1, 2, and 5. Thiopental was used in a 2.5 per cent solution and methohexital in 1 per cent concentration. Fresh solutions of either drug were prepared in specially provided 50 ml. multidose ampoules whenever the previous solution was used up. Since solutions of methohexital are colourless whereas thiopental has a yellowish tint, 1 ml. (6 mg.) of phenolsulfonphthalein was added to each 50 ml. of solution. Thus both solutions were coloured uniformly red and they were coded immediately after preparation. The administrator was not aware at the time of anaesthesia what agent he was using. Because of the different concentration of each agent, the amount administered was recorded initially in millilitres and later was translated into milligrams after the identity of the drugs had been revealed.

All patients were premedicated with meperidine and scopolamine intramuscularly, usually 50 mg. and 0.4 mg. respectively.

Immediately upon induction of anaesthesia, nitrous oxide 8 L. and oxygen 2 L. were administered by mask in a semi-closed system and thereafter supplemental doses of the same agent as had been used for induction were administered when needed to maintain adequate depth of anaesthesia.

In all, 111 patients were studied, of whom 56 received thiopental and 55 methohexital.

Discussion of Results

Age (Table I). The oldest and the youngest patients in both groups are listed as well as the mean ages. Although the extremes of ages were very close, there was a significant difference between the means, the average patient receiving thiopental being almost four years older than the one in the methohexital group. This is surprising since the patients were selected at random. It is unlikely, however, that this difference greatly influences the results of the study.

Height and weight (Table II). As far as the mean height and weight are concerned, there was no difference between the two groups under study.

Time from premedication to induction (Table III). There was no difference between the mean in the two groups. In all previous studies this was the most variable to standardize. In the present study premedication certainly did not influence the validity of the results.

TABLE I
AGE

	Oldest (yrs.)	Youngest (yrs.)	Mean (yrs.)	Mean (mo.)	S.D.	t
Thiopental	62	20	35	7	7.09	2.023*
Methohexital	61	18	31	11	10.66	

*Significant ($P < .05$)

TABLE II

HEIGHT AND WEIGHT

	Mean height (ins.)	S.D.	t	Mean weight (lb.)	S.D.	t
Thiopental	63.5	2.5	−1.089	130.8	26.8	0.049
Methohexital	64	2.3		130.5	24.3	

TABLE III

TIME FROM PREMEDICATION TO INDUCTION

	Longest (hr.)	Longest (min.)	Shortest (min.)	Mean (hr.)	Mean (min.)	S.D.	t
Thiopental	3	46	13.5	1	39	40.9	1.100
Methohexital	3	6	27	1	31	32.24	

TABLE IV

DURATION

	Longest (min.)	Shortest (min.)	Mean (min.)	S.D.	t
Anaesthesia					
Thiopental	35	6	17.6	5.8	−0.587
Methohexital	49	8	18.4	7.3	
Operation					
Thiopental	28	5	12.1	5.0	−0.127
Methohexital	38	5	12.3	6.6	

Duration of anaesthesia and operation (Table IV). Again, there was no difference in the two groups and thus the results for the two drugs are not influenced by these factors.

Amount of drug used (Table V). The well-established fact that methohexital is a more potent drug milligram for milligram than thiopental has once again been corroborated. Both for induction and maintenance and as far as the total dose is concerned, 2½ times the amount of thiopental in milligrams was required than with methohexital. Since thiopental was given as a 2½ per cent solution and methohexital as a 1 per cent solution, the amount of anaesthetic in millilitres administered was identical. This result is at variance with our previous findings in which the ratio of thiopental to methohexital was 1:1.54. This apparent discrepancy can be explained by the fact that in the previous study each drug was used for the entire maintenance of anaesthesia whereas in the present study the burden of maintening anaesthesia was placed upon nitrous oxide and the intravenous barbiturate was used only for supplementation of nitrous oxide. The ratio of 2½:1 is closer to that suggested by other authors who have used methohexital in a similar manner (1, 2).

TABLE V

AMOUNT OF DRUG USED

	Maximum (mg.)	Minimum (mg.)	Mean (mg.)	S.D.	t
Induction					
Thiopental	250	100	133.3	26.3	19.726**
Methohexital	120	50	54.2	14.2	
Maintenance					
Thiopental	375	—	161.8	94.8	7.081**
Methohexital	200	—	65.4	37.2	
TOTALS					
Thiopental	550	125	295.1	95.3	12.764**
Methohexital	250	50	119.6	38.4	

**Highly significant ($P < .01$)

Induction time (Table VI) was defined as the time from completion of the injection of the drug until surgical anaesthesia was reached. The fact that there is no significant difference between the two drugs is once again at variance with our previous findings. We had stressed before that methohexital, being a much more potent drug, must be injected more slowly than is customary for thiopental. Since this was a blind study, thiopental had to be administered at the same slow rate as is mandatory for methohexital. It is obvious, therefore, that if thiopental is used in the same cautious fashion which is essential for methohexital, induction with thiopental is no faster than with the new agent. In other words, the previous findings were due to the fact that liberty is taken with thiopental because of greater experience with this drug.

TABLE VI

INDUCTION TIME

	Longest (min.)	(sec.)	Shortest (sec.)	Mean (sec.)	S.D.	t
Thiopental	2		10	39.9	22.8	0.223
Methohexital	4	30	15	38.6	35.6	

Total sleep time (Table VII) was defined as the time from start of injection until the patient obeyed the simple verbal command of opening the eyes. There was a significant difference between the mean total sleep time, thiopental being the longer acting agent of the two. This confirmed our previous findings that methohexital is a shorter-acting agent and this finding also applies under the changed experimental conditions of the present study.

Waking time (Table VIII). Both the waking time from the last supplemental injection of the intravenous barbiturate and that from the end of inhalation anaesthesia are listed. The end point here again was obedience to simple verbal

command. There was a highly significant difference between thiopental and methohexital, the mean waking time in both instances being much shorter following the administration of methohexital.

Time from wake-up to orientation (Table IX) was the time from obeying simple verbal command to the point when the patient was fully orientated as to place and time. Here again, the effect of methohexital proved less protracted in that patients were orientated sooner than after the administration of thiopental.

TABLE VII

TOTAL SLEEP TIME

	Longest (min.)	Shortest (min.)	Mean (min.)	S.D.	*t*
Thiopental	59	7	25.3	10.9	2.335*
Methohexital	52	10	21.1	7.7	

*Significant ($P < .05$)

TABLE VIII

WAKING TIME

	Longest (min.)	Shortest (min.)	Mean (min.)	S.D.	*t*
From last injection					
Thiopental	50	4	15	9.4	3.653**
Methohexital	33	3	10.3	5.7	
From end of inhalation anaesthesia					
Thiopental	46	1	7.7	9.7	3.803**
Methohexital	9	½	2.7	1.8	

**Highly significant ($P < .01$)

TABLE IX

TIME FROM WAKE-UP TO ORIENTATION

	Longest (min.)	Shortest (sec.)	Mean (min.)	Mean (sec.)	S.D.	*t*
Thiopental	13	0	2	14.4	151.6	2.069*
Methohexital	5	0	1	26.2	85.1	

*Significant ($P < .05$)

Apnoea (Table X). Whereas in our previous study the incidence of apnoea had been greater with thiopental than with methohexital, the mean duration being no different, in the present investigation no difference existed between the two drugs as far as both incidence and mean duration were concerned. Whereas it had been found that, if apnoea did occur with methohexital, it was much more prolonged than after thiopental, this was not found to be so in the present study.

TABLE X

APNOEA

	Incidence	S.D.	t	Mean Duration					
				Apnoeic cases	S.D.	t	All cases	S.D.	t
Thiopental	8(14.3%)	.05	1.636	43 sec.	23.8	0.438	6.1	17.4	1.595
Methohexital	3(5.4%)	.03		37 sec.	7.6		2	8.5	

This was no doubt again due to the fact that thiopental was injected in a slower and more cautious manner than is customary since the identity of the drug was unknown at the time of administration.

Side-effects (Table XI). The only side-effects of note during anaesthesia were movements during maintenance. The high incidence of these movements was due to the fact that their occurrence was the only indication that additional supplements of the intravenous anaesthetic were required. The large majority of these movements were in the category of very slight or slight and as such were not even noticed by the surgeon. These and also moderate movements could be easily controlled by a further injection of anaesthetic. No severe movements which would include withdrawal of the pelvis during manipulation were seen. As one might expect most of the movements occurred at the stage of operation when stimulation was maximal, namely, during preparation of the lower abdomen and vagina with cold water, examination under anaesthesia, and dilatation of the cervical canal. It is, of course, at these stages of greater stimulation that the inadequate depth of anaesthesia becomes most obvious.

TABLE XI

SIDE-EFFECTS

A. TOTAL INCIDENCE

	Cough		Hiccough		Movements	
	Induction	Maintenance	Induction	Maintenance	Induction	Maintenance
Thiopental	0	0	0	0	0	42 (75%)
Methohexital	0	1	0	0	0	46 (83.5%)

B. SEVERITY OF MOVEMENT

	Very slight	Slight	Moderate	Severe
Thiopental	27	10	5	0
Methohexital	30	10	6	0

C. STAGE OF PROCEDURE AT WHICH MOVEMENTS OCCURRED

	Lithotomy position	Vaginal Preparation	Catheterization	Examination under anaesthesia	Dilatation of cervical canal	Curettage	No surgical stimulation
Thiopental	3	19	2	18	9	0	5
Methohexital	4	19	3	13	11	6	6

In comparing thiopental and methohexital one is struck by the similarity of the two agents as far as side-effects are concerned. None of these occurred during induction and even as far as the severity of the movements or the stage of procedure at which they occurred is concerned the incidence is very similar. One would conclude from this that there is no essential difference between the two drugs when they are used under the particular conditions of this study.

Recovery period (Table XII). Untoward manifestations during the recovery period were few with either drug. The incidence of nausea and emesis during the first 24 hours was slightly greater with thiopental than with methohexital, but in no case was the nausea prolonged. Only once was it severe enough to require the administration of perphenazine.

TABLE XII

RECOVERY PERIOD

	Nausea and emesis	Nausea	Headache
Thiopental	5	1	1
Methohexital	1	1	0

SUMMARY AND CONCLUSIONS

One of the most interesting features which has emerged from this study is the apparent discrepancy between our previous study and this one. In the previous study, the identity of each drug was known and was used both for induction and maintenance of anaesthesia. The present study was a blind one and each drug was given for induction of anaesthesia and then during maintenance only if nitrous oxide and oxygen alone were insufficient. These discrepancies emphasize a very basic fact of clinical and of experimental comparisons, namely that when conclusions are drawn as to the comparative properties of two or more agents, it must be clearly stated that the conclusions apply only to the experimental conditions under which the results were obtained. In other words, comparable values are not absolute entities but must be related to circumstances and to the basic experimental assumptions.

The comparison of means has certain limitations which must also be appreciated. In the original study, for instance, following the induction with a barbiturate it was always necessary to give at least one maintenance dose of the barbiturate, whereas in the present study nitrous oxide–oxygen maintenance alone was adequate in four of the thiopental cases and in two of the methohexital cases. Also the cases that remained adequately anaesthetized on nitrous oxide–oxygen alone were by no means always the shortest cases, nor had they received necessarily more than an average amount of barbiturate for induction. Indeed, the two longest cases induced with thiopental and maintained on nitrous oxide and oxygen without further supplement lasted 17 and 19 min. respectively and had received only 125 mg. of thiopental for induction.

Nor is there a clear relation between the wake-up time and the total dose of barbiturate administered. For instance, the longest wake-up time after completion

of inhalation anaesthesia supplemented by methohexital was 9 min. and this patient had received a total of 110 mg. of the drug for induction and maintenance; this is very close to the mean total dose. The shortest wake-up time was 30 sec. and this patient also had received 110 mg. of the same drug. The longest wake-up time after nitrous oxide supplemented by thiopental was 46 min. following administration of 375 mg. The patient who had been given the largest total dose of thiopental, 550 mg., awoke within 4 min. of the end of inhalation anaesthesia, the mean being almost double that time. This at first glance seems odd until it has been calculated that the first patient received 19.5 mg. of thiopental per square meter body surface area per minute of anaesthesia and the second only 14 mg. This and many more or less tangible factors such as degree of apprehension or sedation, metabolic rate, effect of premedication, age, obesity, effect of nitrous oxide, etc., must be taken into account in relating dose to sleep time so that a mere comparison affords only limited information.

If any conclusion can be drawn from such a comparative study as the one here presented, it is this. If thiopental 2½ per cent or methohexital 1 per cent is used for induction of anaesthesia and for supplementation of nitrous oxide–oxygen anaesthesia for a standard operative procedure, and if both drugs are injected at the same rate, the degree of anaesthesia obtained and its quality are *on the average* quite similar, except that awakening following methohexital is quicker, and orientation is faster and more complete than with thiopental. These may be significant factors in out-patient practice and where good recovery room facilities are not available.

Acknowledgment

The authors acknowledge with thanks the assistance of Messrs. N. Purkin and D. Palko, who in their capacity as student interns, assisted with the study.

Professor N. Shklov of the Department of Mathematics did the statistical calculations.

Résumé

Nous avons comparé, par la méthode à l'aveugle, du thiopental à 2½ pour cent et du methohexital 1 pour cent chez 111 femmes en santé qui avaient à subir des opérations gynécologiques mineures. Pour le maintien de l'anesthésie, nous avons employé du protoxide d'azote et de l'oxygène que nous complétions à l'occasion, lorsque nécessaire, avec de petites quantités du barbiturique employé pour l'induction.

Après l'analyse des résultats, il nous semble que, lorsque nous employons ces agents de la façon décrite, il existe peu de différence dans les résultats si ce n'est que, avec le methohexital, le réveil est plus précoce et les malades redeviennent plus tôt complètement lucides.

Ces résultats ne confirment pas dans tous les détails ceux que nous avions obtenus au cours d'études comparatives antérieures de ces deux médicaments, ce que nous attribuons à la technique d'anesthésie différente employée au cours des

deux études. Il est donc important de se mettre dans l'esprit que, lorsque nous faisons des études comparées de médicaments, les résultats ne se superposent pas nécessairement dans toutes les circonstances cliniques.

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MEPAZINE (PACATAL), MEPERIDINE, AND DIHYDROCODEINE (NADEINE) IN LABOUR

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THE SEARCH for the ideal analgesic agent or combination for pain relief in labour has proceeded in recent years with the diligence of alchemists seeking to transmute lead into gold. While the borders of the problem have become more clearly defined, many workers feel that ideal analgesia is a goal which must be aimed at, but one which is unlikely to be achieved. All effective systemic analgesic agents are respiratory depressants, and adequate pain relief in the mother with these drugs can often only be achieved at the price of delayed respiration in the infant.

Conduction techniques of spinal and epidural, regional and local anaesthesia are not applicable in every labour, and can only be safely practised in centres with adequate facilities.

Prenatal instruction of the mother and positive efforts to secure a relaxed co-operative patient in labour can do much to reduce the dosage of systemic analgesics, but there will be many occasions in many institutions where these drugs will be required to alleviate distress.

Recently, attention has been directed to the combination of reduced doses of analgesics with phenothiazine derivatives. These latter drugs have a powerful and distinctive central sedative action, and potentiate narcotic and hypnotic drugs, although they have no analgesic action of their own. Reduction in the dosage of analgesic required is thought to be reflected in a lower incidence of infants requiring active resuscitation.

Chlorpromazine was reported by Savage (5) to produce marked calming and potentiation of analgesics, without depressing foetal respiration or adversely affecting the third stage of labour. Unfortunately, he also found marked prolongation of labour and an increased incidence of forceps delivery, indicating depression of uterine tone.

Promethazine has been reported by Carroll and his colleagues (1, 3) to produce a slight reduction in the length of labour, a definite reduction in meperidine dosage, and calm co-operative conditions in labour. The reduced dosage of meperidine resulted in undepressed infants, and an apparent reduction in pulmonary disorders of neonates occurred.

In a preliminary report on mepazine (Pacatal) by the author (6) similar calming effects with no apparent depression of uterine contractions were noted in the mother, while the infants appeared active and showed no evidence of respiratory depression. Other side-effects of phenothiazine derivatives such as hypotension, vasodilation, and restlessness were minimal.

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The present investigation was undertaken to obtain a more accurate assessment of the effects of mepazine on labour, and upon the foetus, when used alone, or in combination with other analgesic drugs.

Agents

Mepazine was used in combination with two analgesic agents. Meperidine, chosen as the systemic analgesic most commonly employed in obstetrics, was alternated with a newer analgesic, dihydrocodeine (Nadeine). Dihydrocodeine is a synthetic derivative of morphine elaborated in 1935 and recently reassessed by Beecher's group in Boston (2). They found that it was a potent analgesic in postoperative pain, though 12 per cent weaker than morphine, and had the advantage of minimal side-effects at optimum dose levels. The use of dihydrocodeine with scopolamine in obstetrics has been reported by Ruch and Ruch (4) and it was felt that this drug potentiated by mepazine would provide effective analgesia with minimal respiratory depression.

Material

Details were recorded from all public and semi-public patients admitted to the labour wards of the Royal Victoria Hospital, Montreal, between January 25 and July 29, 1958. Two-thirds of these patients could not understand English, one-third being French-speaking only, and the remaining third consisting of patients who could speak only Greek, Italian, German, Hungarian, Ukrainian, Jugoslavian, Finnish, or Chinese. These patients were, therefore, not accessible to verbal reassurance and explanation in the majority of instances.

TABLE I

Numerical Distribution of All Cases Delivered between January 25 and July 29 on Wards under Observation, with Analysis of Cases Excluded from Series

	Control	Trial	
No drugs	94	199	
Demerol only	102	47	
Pacatal only	—	144	
Pacatal and Demerol	—	104	
Pacatal and dihydrocodeine	—	101	
Dihydrocodeine alone	—	14	
Other drugs	14	35	
Total cases included	210	644	854
Exclusions			
Stillborn	7	14	
Prematures excluded (less than 28 weeks)	1	3	
Caesarean section	7	23	
Born before admission	1	1	
Total cases excluded	16	41	57
All Cases			911

It was decided to exclude those undergoing Caesarean section, those in whom labour resulted in a stillbirth, or the birth of a foetus of less than 28 weeks maturity, and those admitted to the labour ward after delivery.

The numerical distribution of the cases in the control and in the trial period, together with an analysis of exclusions is shown in Table I.

Method

Proformae were prepared for recording the details of labour, the state of the foetus before and after delivery, and the timing and dosage of drugs given:

Proforma for Recording Labour Details

Infant

Addressograph stamp

Foetal distress before delivery:
Tachycardia/Bradycardia
Irregularity/Meconium
Cord around neck Yes/No
Condition at birth: Tone: Good/Fair
Poor/Absent

Cyanosis: Slight/
Moderate/Marked

Time from delivery to rhythmic spontaneous respiration.....secs.

Resuscitation: O_2 Bag & Mask/Art, Respn.
Resp. Stim./Narcotic Ant.

Heart rate at 1 min.: Under 100/100–160
Over 160

Respiration at 1 min.: Reg. & deep
Reg & shallow
Irregular
Gasping
None

Ref. Anaesthesia and Analgesia:
Co-operation of patient: Good/fair/poor
Pacatal: No. of doses
Demerol: No. of doses
Dihydrocodeine: No. of doses
Barbiturate: No. of doses
Trilene analgesia for.....mins.
Gen. Anaesthesia: Agents:

Mother

Gravida:
Due Date:
Admitted:.....am/pm
Date

1st Stage began.....am/pm, on.....
2nd Stage began.....am/pm, on.....
Delivered:.....am/pm, on.....
3rd Stage complete....am/pm, on.....

Position:
Type of Delivery: Spont./Forceps/
Posterior/rotation/Breech/
Extraction

Del of Placenta: Spont./Fundal P./
Man. Rem.

Placenta: Normal/Infarcted/
Old retroplacental clot
Blood Loss: ..... cc.s

Total dose Time of last dose
Total dose Time of last dose
Total dose Time of last dose
Total dose Time of last dose
N_2O, O_2 analgesia for.....mins.
Time to delivery.....mins.
Total duration.....mins.

The initial observations on these proformae were recorded by the anaesthetists, where they were present at cases receiving inhalation analgesia or anaesthesia for delivery. Where an anaesthetist was not present, information was extracted by the investigator from similar records maintained by the obstetric staff.

The investigator completed the proforma in all cases, using the above sources, the patients' hospital records, and the replies to questions directed to the patients within 48 hours of delivery on their attitude to the labour and the analgesia received. Where possible these questions were posed in the patients' own language with or without the aid of an interpreter.

POST-DELIVERY QUESTIONNAIRE

Completed within 48 hours of the delivery.

(1) *Primigravidae*: Was labour better than expected?
worse than expected?
as expected?

(2) *Multigravidae*: Was labour better than previous labours?
worse than previous labours?
the same as previous labours?

(3) At its worst was the pain experienced mild?
severe?
unbearable?

(4) Was the relief of pain by injections good?
fair?
poor?
nil?

(5) While you were awake was the relief of pain by mask good?
fair?
poor?
nil?

(6) Do you remember admission, rupture of membranes, enema, being transferred to delivery room, birth of the baby, delivery of the afterbirth, returning to this ward?

The investigation was divided into three periods, each designed to end when 100 case records of the main drug concerned were obtained. The periods were:

(*a*) Control period, January 25–March 19, during which the current practice was observed, with no attempt to influence the type, time or dosage of drugs given.

(*b*) Period where the analgesic was limited to meperidine and instructions were given for all patients to receive mepazine by mouth in a dosage of 0.75 mg./kg. every 4 hrs. from the time of admission onwards, provided that they were experiencing regular labour pains.

(*c*) Period where the analgesic was limited to dihydrocodeine and instructions for giving mepazine continued as in (*b*) above.

In both groups (*b*) and (*c*) the timing and dose of the analgesic drug was left entirely to the discretion of the obstetric staff, apart from an initial suggestion that some reduction in dosage might be achieved without loss of analgesia.

Group (*b*) and (*c*) became intermingled in random fashion by the substitution of dihydrocodeine for meperidine in certain delivery rooms without the knowledge of the investigator or the obstetric staff, at a point halfway through the group (*b*) period, so that the two groups ran side by side for a short time. When this became apparent, dihydrocodeine was prescribed until group (*c*) was complete, and the trial ended by completion of the last third of group (*b*).

Results

For comparison, the records may be divided into eight groups, seven according to the drugs received within 12 hours of delivery, and a control group consisting of the patients in the control period. These received no drugs, meperidine alone, or other drug combinations. The drug groups are: no drugs, meperidine alone, meperidine with mepazine, mepazine alone, dihydrocodeine with mepazine, dihydrocodeine alone, and other drugs. These other drugs were mainly barbiturates given for sleep in what was thought to be early labour, or for sedation in toxaemia, but on occasion morphine, heroin, alphaprodine, chlorpromazine, or narcotic antagonists were given before delivery.

The numerical distribution of these groups divided according to parity is shown in Table II. The small numbers in the case of the dihydrocodeine alone

TABLE II

Numerical Distribution of Cases by Groups According to Drugs Received

Group	Primigravidae	Multigravidae	
No drugs			
Controls	16	79	
Trials	30	168	
Total	46	247	
Demerol only			
Controls	56	47	
Trial	24	22	
Total	80	69	
Demerol and Pacatal	57	47	
Pacatal only	42	102	
Dihydrocodeine only	8	6	
Dihydrocodeine and Pacatal	55	46	
Other drugs			
Controls		7	
Trial		22	
Total	20	29	
Exclusions	21	36	
Total included	308	546	854
Total excluded			57
Grand total			911

group result from the decision to abandon the use of this drug alone due to unsatisfactory analgesia.

Effects on the Infant

The main assessment of drug effects in the infant is based on a comparison of the time to regular rhythmic respiration as distinct from time of the first breath or cry. While this is a more difficult end point to assess, it offers a more reliable measure of the state of depression since drug-depressed infants may be born well oxygenated and with good tone, and may grimace or cry, or make a few gasping respirations before relapsing into an apnoea which tends to be prolonged by the ensuing anoxia. These observations were recorded by thirteen anaesthetists, and it is felt that any individual bias in determining the end point would be compensated by an opposite bias in other observers.

There was a significant difference ($P < .05$–$P < .001$) in four out of eight groups between infants of primigravidae and infants of multigravidae, so that these groups have been compared separately and are shown in Table III.

TABLE III

COMPARISON OF TIME TO REGULAR RESPIRATION IN INFANTS ACCORDING TO DRUG GROUP AND PARITY OF MOTHER

Group	Infants born of primigravidae (mean time in sec.)	Infants born of multigravidae (mean time in sec.)
Controls	88.6	34.2
No drugs	65.6	48.0
Demerol only	69.8	38.0
Demerol and Pacatal	75.3	46.0
Pacatal only	44.7*	30.4
Dihydrocodeine only	133.0	25.0
Dihydrocodeine and Pacatal	70.3	55.2
Other drugs	109.3	75.9

*Significantly faster than control ($P < .05$).

As can be seen, there is little evidence of drug depression in any group except the dihydrocodeine alone and the other drug groups, and the numbers here are too small to be significant.

However, the respiration time in the mepazine group is faster than control ($P < .05$ in primigravidae) and faster than dihydrocodeine ($P < .02$ in primigravidae) and closely approaches significance when compared with those receiving no drugs. This suggests that of itself mepazine tends to stimulate the earlier onset of foetal respiration.

Among other factors which may affect the regular respiration time of infants are signs of foetal distress before delivery, the percentage of infants showing delay in reaching regular respiration beyond 2 min. and the incidence of infants requiring active resuscitation. These are compared in Table IV.

TABLE IV

COMPARISON OF THE INCIDENCE OF FOETAL DISTRESS, DELAYED RESPIRATION, AND ACTIVE RESUSCITATION IN DRUG GROUPS, BY PARITY

Group	Infants showing distress (%)		Infants breathing later than 2 min. (%)*		Infants requiring resuscitation (%)	
	Primigravidae	Multigravidae	Primigravidae	Multigravidae	Primigravidae	Multigravidae
Control	20.0	6.8	16.3	4.5	12.5	2.3
No drug	13.0	11.3	19.6	5.3	10.9	2.8
Demerol only	23.7	10.1	13.8	8.7	11.3	5.8
Demerol and Pacatal	15.8	14.9	24.6	6.4	17.5	6.4
Pacatal only	30.9	12.7	16.7	2.9	9.5	1.0
Dihydrocodeine only	0.0	0.0	37.5	0.0	50.0	0.0
Dihydrocodeine and Pacatal	14.5	13.0	18.0	13.9	12.7	15.2
Other drugs	20.0	6.9	25.0	10.3	15.0	6.9

*Breathing regularly and rhythmically.

Foetal distress was noted most frequently in primigravidae receiving mepazine only, and next most frequently in those receiving meperidine only, while in multigravidae the highest incidence occurs in the group receiving mepazine with meperidine or with dihydrocodeine. However, the variations either side of control are such that these could have arisen by coincidence, and cannot be consistently ascribed to any one drug or combination. Moreover, the correlation between signs of foetal distress and the occurrence of delayed respiration was very poor, only 5 per cent of all distressed infants showing delay. The most reliable indication of distress was bradycardia, alone or with irregularity, or a combination of any three signs of foetal distress.

Surprisingly, the correlation between prematurity or post-maturity, judged from the calculated date of delivery, and delayed respiration was also poor: 7.54 per cent of infants born to the 854 mothers were born before the thirty-sixth week, and 5.8 per cent after the forty-fourth week. Of these infants, only 10.7 per cent of prematures and 16 per cent of post-matures showed any delay in attaining regular respiration.

Many infants showing delay in the onset of regular respiration were breathing adequately and required no resuscitation. Conversely, many infants thought to require resuscitation were rapidly revived and showed no delay in achieving regular respiration. All infants were suctioned with mucus catheters and placed in a warm 40 per cent oxygen atmosphere. Active resuscitation consisted of giving 100 per cent oxygen to a breathing infant, using a bag and mask. Very rarely, endotracheal intubation was performed to enable the airway to be aspirated more thoroughly.

Primigravidae receiving meperidine with mepazine showed the highest incidence of delayed respiration and their infants required resuscitation more frequently. Since this group had the highest incidence of abnormal positions of the foetus at the onset of labour (that is, any position other than left or right occipito anterior), this finding is not unexpected, and cannot be attributed to the particular drug combination.

Drug Dosage and Timing (See Table X)

There was a significant difference in dosage in all groups receiving narcotics between multigravidae and primigravidae, varying between $P < .05$ to $P < .001$. There is a highly significant difference ($P < .001$) between the dosage of meperidine alone (mean: 151.2 in primigravidae, 105.4 mg. in multigravidae) and the dosage of meperidine when combined with mepazine (mean: 80.0 in primigravidae, 75.5 in multigravidae).

Dihydrocodeine when given alone in doses of 30–50 mg., resulted in a degree of analgesia which was obviously inadequate in the judgment of the obstetric and nursing staffs. Over 50 per cent of the patients also stated that they received poor or no relief of pain from dihydrocodeine alone. Indeed, many denied they had received an analgesic, being under the impression that the injection had been given with the object of accelerating labour. Dihydrocodeine possesses a central excitatory activity similar to that shown by codeine, and might well affect uterine

activity in this way. There is evidence in comparing the length of labour between groups that this impression is correct.

Since the main criterion for comparisons between the groups is that, objectively, equivalent pain relief should have been attained in each group, the differences between those receiving dihydrocodeine alone and those receiving dihydrocodeine and mepazine are not considered comparable, especially in view of the small numbers in the former group. In the dihydrocodeine with mepazine group, satisfactory analgesia was obtained with a 50–75 mg. dose, followed in the case of the smaller initial dose, by a second dose of 30 mg. in 2 hours. However, these higher dosage levels were followed by an increased incidence of delayed respiration in the infants, and a higher percentage of infants requiring active resuscitation, especially noticeable in infants of multigravidae.

The mean dosage of narcotic in the group receiving dihydrocodeine alone was 56 mg. for primigravidae and 38.3 mg. for multigravidae, in contrast to the group receiving dihydrocodeine with mepazine, where the mean dosage was 75 mg. for primigravidae, and 52.9 for multigravidae.

There was no significant difference in the timing of the last dose of narcotic given to groups receiving narcotic alone as compared to groups receiving narcotic with mepazine, but the interval between the last dose and delivery was longer in the case of primigravidae (3.1–4.6 hours) than of multigravidae (2.1–2.9 hours).

Effects on the Mother

Clinical impressions of the obstetric staff and nursing staff were very favourable, and most remarked spontaneously that the labour wards had become quieter and more orderly. Patients rested well between pains and apprehension and fear were minimal in a group where the majority could not be reassured because of language difficulties.

The length of labour was recorded from the onset of regular rhythmic pains to the completion of the delivery of the placenta. In some cases, contractions, after being regular, became irregular and in some labour was suspended, sometimes for as long as 48 hours. Nevertheless, since the labour process had started, onset of labour was accepted as defined above. Thus the mean labour times, given in Table V, tend to be a little longer in each group than those reported from other institutions.

Considering primigravidae, there was no significant difference in length of labour between those receiving no drugs, those receiving mepazine alone, and those receiving dihydrocodeine alone. Moreover, those receiving mepazine alone showed significantly shorter labour times than those receiving meperidine alone, meperidine with mepazine, dihydrocodeine with mepazine, and those in the control group. While the small numbers make it unwise to draw conclusions in the dihydrocodeine alone group, mepazine alone is shown to have a beneficial effect in shortening labour.

In the multigravidae, however, there are no significant differences except in the group receiving meperidine and mepazine alone, where labour is significantly slower than control.

TABLE V

COMPARISON OF MEAN LABOUR TIMES (IN HOURS)

Group	Primigravidae				Multigravidae			
	First stage	Second stage	Third stage	Total	First stage	Second stage	Third stage	Total
Controls	23.84	0.85	0.21	24.95	10.42	0.43	0.18	11.28
No drugs	10.8	0.77	0.14	11.8	9.04	0.43	0.16	9.6
Demerol only	21.52	0.92	0.19	22.63	11.6	0.37	0.16	12.7
Demerol and Pacatal	19.5	1.1	0.22	20.46	14.95	0.63	0.18	15.76†
Pacatal only	13.52	1.18	0.18	15.12*	10.99	0.52	0.17	11.69
Dihydrocodeine only	17.15	0.59	0.2	17.94	11.55	0.32	0.17	12.03
Dihydrocodeine and Pacatal	19.29	1.03	0.18	20.24	12.65	0.43	0.16	13.23
Other drugs	27.85	1.13	0.13	29.07	15.4	0.46	0.18	16.03

*Difference between Pacatal only group and groups receiving Demerol alone, Pacatal with Demerol, and Pacatal with dihydrocodeine significant at $P < .02$ level. Difference between Pacatal and control groups significant at $P < .01$ level.

†Significantly slower than control: $P < .01$.

In the individual stages, similar differences are present in the first stage, and the third stages are of similar length in all groups, but the second stage in groups receiving mepazine is slightly longer than other groups, though the difference is not significant.

Co-operation in the second stage of labour is shown in Table VI. Primigravidae receiving mepazine alone co-operated better than any other group, while those receiving meperidine alone or in combination with mepazine were similar to controls. Those receiving no drugs, and those receiving meperidine and mepazine showed the highest percentage of poor results, but once again, the high incidence of abnormal positions in this latter group should be borne in mind.

TABLE VI

CO-OPERATION OF PATIENTS IN THE SECOND STAGE OF LABOUR BY DRUG GROUP AND PARITY (%)

Group	Primigravidae				Multigravidae			
	Good	Fair	Poor	Not recorded	Good	Fair	Poor	Not recorded
Control	53.7	17.5	6.3	22.5	38.3	12.8	5.3	43.6
No drugs	37.0	6.5	15.2	41.3	38.1	11.3	4.0	46.6
Demerol alone	55.0	17.5	5.0	22.5	49.4	13.0	5.8	31.8
Demerol and Pacatal	50.9	19.3	17.5	12.3	32.0	27.7	2.1	38.2
Pacatal alone	61.9	14.3	2.4	21.4	50.0	15.7	8.8	25.5
Dihydrocodeine alone	37.5	12.5	0.0	50.0	10.3	0.0	0.0	89.7
Dihydrocodeine and Pacatal	50.9	18.2	3.6	27.3	45.6	23.9	4.3	26.2
Other drugs	45.0	15.0	5.0	35.0	24.1	17.2	3.5	55.7

In multigravidae the results are similar in all groups if it is assumed that the non-recorded results would have occurred in the same ratio as the recorded results. Once again, there is a marked increase in the incidence of fair and poor co-operation, in the group with many abnormal labours.

The incidence and type of anaesthesia are shown in Table VII. Nitrous oxide–oxygen–trichlorethylene was the general anaesthetic most frequently employed, unconsciousness supervening at or a few minutes before crowning of the foetal head. Pudendal block was the most common type of local anaesthesia, though saddle block spinal and epidural were used on occasion.

TABLE VII

NATURE OF ANAESTHESIA GIVEN FOR DELIVERY IN EACH GROUP, BY PARITY (%)

Group	Primigravidae			Multigravidae		
	General	Local or regional	None	General	Local or regional	None
Control	82.5	3.75	13.75	60.9	1.5	37.6
No drug	78.25	13.0	8.75	57.5	3.6	38.9
Demerol alone	81.3	7.5	11.2	65.2	1.4	33.4
Demerol and Pacatal	82.5	6.3	6.2	68.1	6.4	25.5
Pacatal alone	73.8	7.2	19.0	60.8	2.0	37.2
Dihydrocodeine alone	75.0	12.25	12.25	50.0	16.6	33.4
Dihydrocodeine and Pacatal	72.7	7.3	20.0	69.6	4.3	26.1
Other drugs	70.0	10.0	20.0	27.6	0.0	7.24

The records of blood lost are based on estimates given by the obstetric staff, and there is no significant difference between the groups or between primigravidae and multigravidae. The incidence of post partum haemorrhage (blood loss over 500 cc.) was higher in primigravidae than in multigravidae in all groups and is shown in Table VIII. There was a higher incidence in groups receiving narcotics alone, than in the groups receiving mepazine alone or in combination with a narcotic.

TABLE VIII

PERCENTAGE INCIDENCE OF FORCEPS DELIVERY AND POST PARTUM HAEMORRHAGE BY DRUG GROUP AND PARITY

Group	Forceps delivery		Post partum haemorrhage	
	Primigravidae	Multigravidae	Primigravidae	Multigravidae
Control	33.8	3.0	13.8	4.5
No drugs	26.0	4.1	6.5	3.2
Demerol alone	38.8	5.8	10.0	1.4
Demerol and Pacatal	50.9	17.0	8.7	6.4
Pacatal alone	38.0	7.8	7.1	5.9
Dihydrocodeine alone	50.0	0.0	12.5	0.0
Dihydrocodeine and Pacatal	49.1	13.0	7.3	2.2
Other drugs	41.4	3.5	20.0	6.9

Consideration of the forceps rate shows the combination of mepazine with narcotics, or mepazine alone, to be associated with an increased incidence of forceps delivery in both primigravidae and multigravidae.

In assessing analgesia, the difficulties of evaluating replies from patients are recognized since their answers may be modified by the psychological elation or

depression phases of the puerperium. However, leading questions were avoided by putting the question in the form of a choice between three alternatives, with no attempt to guide the patient to a particular reply. The replies were assigned unit values, being lowest for the favourable and highest for the unfavourable alternative, and on totalling the values, a score is arrived at for each patient which is taken as a measure of the discomfort experienced. These scores are compared in Table IX.

TABLE IX

COMPARISON OF ANALGESIA SCORES OBTAINED FROM RESPONSES TO QUESTIONNAIRE

Group	Primigravidae (mean score)*	Multigravidae (mean score)*
Controls	3.4	2.8
No drugs	2.0	2.0
Demerol only	3.7	4.0
Demerol and Pacatal	4.4	5.3
Pacatal only	2.4	2.3
Dihydrocodeine only	5.7	4.4
Dihydrocodeine and Pacatal	4.3	4.6
Other drugs	3.24	3.14

*1–2.9 = Excellent 5–6.9 = Poor
3–4.9 = Good Over 7 = Very poor
Compared with Demerol only, difference significant $P > .001$
Compared with Demerol only, difference significant $P > .02$.

Those who received no analgesic could not, of course, score on this account, but if they experienced severe or unbearable pain because an analgesic was judged not necessary, their score would rise. On the other hand, those obtaining good relief from air analgesic would not add to their score. It will be seen that those who received mepazine with meperidine or dihydrocodeine, or dihydrocodeine alone, suffered more discomfort than those receiving meperidine only. On the other hand, those who received mepazine alone suffered less discomfort than those who received meperidine.

TABLE X

MEAN DOSAGE AND TIME OF ADMINISTRATION OF DRUGS BY GROUPS

Group	Mean drug dose (mg.)		Mean time of last dose (hrs.)	
	Primigravidae	Multigravidae	Primigravidae	Multigravidae
Demerol in controls	151.2	105.4	3.7	2.7
Demerol in Demerol only group	139.0	102.6	3.5	2.4
Demerol in Pacatal-Demerol group	80.0	75.5	4.6	2.9
Dihydrocodeine in dihydrocodeine only group	56.0	38.3	3.1	2.1
Dihydrocodeine in dihydrocodeine-Pacatal group	75.0	52.9	3.8	2.3
Pacatal in Pacatal only group	182.0	167.3	3.7	2.5
Pacatal in Pacatal-Demerol group	267.0	229.0	3.6	3.4
Pacatal in Pacatal-dihydrocodeine group	259.0	179.9	3.5	3.1

Conclusions

The many factors which interact in any individual labour make the assessment of any drug effects very difficult, and no drugs are more difficult to assess than analgesics or analgesic combinations. However, in reviewing the material presented, the following conclusions seem justified.

By itself, mepazine has no influence on the length of labour in primigravidae or multigravidae and tends to stimulate the earlier onset of respiration in their infants. It will also give satisfactory sedation and relief of apprehension in a proportion of patients who would otherwise be given meperidine for this purpose. It increases the incidence of forceps delivery.

In combination with meperidine, there is potentiation of all the effects of the narcotic, and a marked reduction in dosage results. Because of this potentiation, the tendency of meperidine to depress foetal respiration is present almost to the same degree as with the higher dosage. Again, meperidine tends to lengthen labour through a reduction in uterine tone, and this effect is potentiated by mepazine, so that labour tends to be lengthened to almost the same degree as with the higher dose of meperidine. However, this effect is less noticeable in primigravidae than in multigravidae, probably because labour is lengthened by apprehension and poor relaxation, and these are more common in primigravidae than multigravidae.

Although to the observer, the combination of meperidine and mepazine appears to produce better analgesia than meperidine alone; in the early puerperium, patients state that they suffered more discomfort with the combination.

Mepazine had no adverse effects on the third stage of labour, and no cases of liver dysfunction or depression of bone marrow occurred in patients receiving the drug.

Dihydrocodeine proved to be an inadequate analgesic in labour in 30–50 mg. doses, and attempts to increase the dose only resulted in increased respiratory depression in infants, with little increase in analgesia. Combined with mepazine in 30–75 mg. doses, analgesia was comparable to that attained with meperidine and mepazine, and while labour was shorter, there was an increased incidence of delayed respiration in infants.

Summary

A controlled trial of mepazine (Pacatal) alone and in combination with meperidine (Demerol) or dihydrocodeine (Nadeine) in a series of 854 obstetrical patients is reported.

Mepazine alone stimulates the earlier onset of respiration in infants, does not lengthen labour and has no adverse effects on the third stage of labour. However, alone or in combination with a narcotic, mepazine increases the incidence of forceps delivery.

In combination with meperidine, satisfactory sedation and co-operation were obtained during labour, and a marked reduction in meperidine dosage resulted. In primigravidae, labour was shortened. The combination produced no greater respiratory depression in infants than did meperidine alone.

Dihydrocodeine given alone in 30–50 mg. doses was an unsatisfactory analgesic in labour. Combined with mepazine, satisfactory sedation and co-operation were produced with 30–75 mg. doses, but at the price of increased respiratory depression in infants.

Résumé

Voici le résultat de l'essai contrôlé de la mepazine (Pacatal) seule et en association avec la mépéridine (Demerol) ou la dihydrocodeine (Nadeine) chez 854 cas d'obstétrique.

Si elle est employée seule, la mepazine stimule la spontanéité respiratoire des enfants, elle ne prolonge pas le travail et elle n'a pas d'effets contraires sur le troisième stage du travail. Toutefois, qu'elle soit employée seule ou en association avec un narcotique, la mepazine augmente la fréquence des prises de forceps.

En l'associant à la mépéridine, nous avons obtenu durant le travail une sédation et une coopération satisfaisante et, de ce fait, les doses de meperidine ont été fortement diminuées. Chez les primipares, le travail a été plus court. Chez les enfants, la dépression respiratoire n'a pas été plus marquée avec l'association qu'avec la mépéridine seule.

La dihydrocodeine, employée seule, à la dose de 30–50 mg. au cours du travail, ne s'est pas avérée un analgésique satisfaisant. Associée à la mépazine à la dose de 30–75 mg., elle a donné une sédation et une coopération satisfaisantes, mais au prix d'une dépression respiratoire plus marquée chez les enfants.

Acknowledgments

I should like to thank Dr. A. B. Noble, Dr. G. B. Maughan, Miss M. Fraser, and the anaesthetic and obstetric and nursing staffs, whose interest and co-operation proved invaluable. Warner-Chilcott Laboratories provided the Pacatal used in this series and gave valuable assistance in the preparation of records for analysis. Nadeau Laboratories provided generous supplies of Nadeine.

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EPIDURAL ANAESTHESIA FOR LUMBAR LAMINECTOMY AND SPINAL FUSION[1]

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THIS STUDY is limited to anaesthesia for operations on the lumbar and lumbosacral spine. It includes operations for correction of disorders of the intervertebral discs, of abnormal articular mobility and of other anomalies such as spondylolisthesis. It excludes new growths and infective processes.

These operations are, for the most part, conducted on otherwise healthy, and, usually muscular, individuals in the 30- to 50-year age group, the great majority being males.

The approach to the lumbar spine is rendered difficult by the size of the muscle mass, and the ultimate corrective part of the procedure is carried out in the depth of a narrow confined space, whose floor is readily obscured by oozing of blood.

POSITIONS USED

At this centre the majority of these operations are performed with the patient in the prone position with bolster supports, and with varying degrees of table flexion. Alternatively the lateral position with thighs and knees flexed is much less frequently used, and rarely the squatting position is employed.

ANAESTHETIC CHOICE

In order to provide good operating conditions, the anaesthesia should ensure a reasonably dry surgical field, with adequate muscle relaxation, and guarantee the safety of the patient. The procedures so frequently entail the use of electrical coagulating currents that the choice of a non-explosive anaesthetic technique is mandatory. Changes of posture in an anaesthetized patient, such as turning from the supine to the prone position or vice versa, can cause dramatic falls in blood pressure, and have been known to produce cardiac arrest. With this in mind, the choice of subarachnoid block offers a big advantage in that it can readily be induced with the patient already in the prone operating position, when a hypobaric solution is used. Epidural analgesia, on the other hand, is usually induced in the lateral position with flexion of thighs and knees, but because there is incomplete loss of motor power the patient himself can assist in his change to the prone position with a resultant lesser effect on haemodynamic stability, or alternatively he may position himself before the block becomes effective without any physiological upset whatsoever.

[1]Presented at the Section of Anaesthesia, Conjoint Meeting British Medical Association and Canadian Medical Association, Edinburgh, July 22, 1959.

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General anaesthesia suffers greater disadvantages in this respect. Furthermore it is the impression of many of the surgeons and anaesthetists at this centre that more annoying bleeding occurs with this method, in the presence of adequate ventilation, than with regional methods, the end results of this being a prolongation of the operating time as well as increased demands on the blood bank.

MacMillan (1) claimed satisfactory operating conditions with minimal blood loss and few postoperative sequelae, using epidural block. Lucca Escobar, and Castillo (2) reported superior results in 34 cases using catheter epidural Xylocaine or Metycaine block. On the other hand, Bonica *et al.* (3) reported results inferior to subarachnoid block in 66 cases, in that analgesia was not always complete. They postulated that this might be due to interference with spread of the anaesthetic solution by the lesion. However, the paper of Lucca Escobar and Castillo (2) reported no difficulty in this respect. Bromage (4) states that epidural block with a stronger-than-usual addition of adrenalin (epinephrine) provides excellent operating conditions for laminectomies.

This paper attempts to analyse and compare the results of 211 lumbar laminectomies and/or spinal fusions performed at the Vancouver General Hospital in the past three years. Of these, 93 cases had epidural block, 29 had combined epidural block and general anaesthesia, 27 had subarachnoid block, 26 had general anaesthesia using N_2O and Pethidine (Demerol), and 29 cases had general anaesthesia with N_2O and Fluothane (halothane). During the past 12 months, a careful measurement of blood loss has been made in each case and the results are compared later in this paper.

Selection of Cases

Choice of method was determined by acceptability to the patient, by the anticipated duration of the operative procedure, and by the anticipated technical facility or difficulty of producing regional block. Regional analgesia was avoided, first, when the patient had strong objections to the method and secondly when such severe pain and acute muscle spasm were present that suitable positioning would have been impossible. Regional and general anaesthesia involving endotracheal intubation was employed for anticipated very lengthy procedures, and general anaesthesia alone was used when the patient refused to consider regional methods. Previous laminectomy or spinal fusion was not necessarily considered a contraindication to either subarachnoid or epidural block.

Epidural Block

Method

The agent used for all patients was 2 per cent Xylocaine (lidocaine, lignocaine) with 1:300,000 adrenalin (epinephrine). A standard dosage of 20 ml. was injected at L2–3 or L3–4 in all patients. Catheters were not employed in any case. There was considerable variation in the height of analgesia obtained with this standard dose, the average being to T6 or T7. In two patients, analgesia did not extend higher than the level of the site of injection, although it was adequate below this level. In one patient, analgesia was patchy below the L3 dermatome although

adequate above this level and extending as far as T4. In one case in which the myelogram showed a complete block there was a slight delay in the onset of analgesia below the level of the lesion, but analgesia became complete within 5 min. after the area above the lesion. In one patient there was considerable pain on injection of the analgesic solution no matter how slowly this was done. This patient had had a previous laminectomy, and at this present operation the ligamentum flavum was found to be extensively adherent to the dura mater at the site of laminectomy. However, there was no difficulty with diffusion of the solution which gave complete analgesia above and below the lesion. In this series, then, diffusion below the lesion was not a problem, failure having occurred in one case only.

Hypotension

Prophylactic vasopressor drugs were not used routinely pre-induction, and in no case was there any sudden severe hypotension. A more gradual lowering of the blood pressure was the rule with the lower limits becoming manifest very shortly after the establishment of the full extent of analgesia. Depression of systolic blood pressure below an arbitrary figure of 75 mm. Hg was controlled by fractional doses of a vasopressor drug such as Methedrine (methyl amphetamine). Recourse to these was not frequently required.

Duration of Analgesia

Duration ranged from 2½ to 4 hours, the average being about 3 hours. Most patients were given "sleeping" doses of Nembutal and/or Thiopentone (Pentothal), and in the longer procedures waning analgesia was supplemented with intravenous Pethidine (Demerol) either in fractional doses or in the form of a continuous drip.

Ventilation

No artificial airway was used in any case. Lucca Escobar and Castillo (2) reported airway difficulties associated with nasal congestion occurring in the prone position. This difficulty was not experienced in this series. Inefficiency of respiratory effort due to high block did not occur in any case. An increase in the amount of bleeding was usually noted about the 2-hour mark and occurred so regularly that it was attributed to the termination of the local action of adrenalin rather than to the accumulation of CO_2 resulting from possible inadequate ventilation.

Muscle Relaxation

In the majority of patients the muscle relaxation was satisfactory, although inferior to that obtained by subarachnoid block. In one or two cases the surgeon commented that the muscle was "a little tight."

Blood Loss

The general impression was that the operative field was drier with this type of block than with any other method, particularly deep down in the wound in the paravertebral tissues. Surgery was thereby facilitated and took less time. A

comparison of the actual amounts of blood loss are given in the following tables. It should be noted that in the patients given general anaesthesia breathing was either spontaneous or assisted manually. Positive-negative phase ventilators were not used.

Table I suggests that in the case of "laminectomy only" there is no appreciable difference in the blood loss with any of the methods, save perhaps in the cases done with N_2O/Pethidine. However, the number of cases done with the latter method is too small to be significant.

TABLE I

LAMINECTOMY ONLY

Agent	No. of cases	Percentage given blood or blood substitute	No. of cases	Average case measured blood loss (cc.)
Epidural	36	2.7	21	214
Subarachnoid block	5	0	5	209
Combined epidural and general	6	0	0	—
N_2O/Pethidine	2	0	2	337
N_2O/Fluothane	7	14	7	208

TABLE II

LAMINECTOMY AND SPINAL FUSION

Agent	Without iliac bone			With iliac bone		
	No. of cases	Percentage given blood or blood substitute	Case average blood loss	No. of cases	Percentage given blood or blood substitute	Case average blood loss
Epidural	9	22		48	35	
	5		322 cc.	14		298 cc.
Subarachnoid	4	50		18	56	
Block	0		—	5		615 cc.
Combined	8	25		15	67	
Epidural & General	3		297 cc.	5		494 cc.
N_2O/	11	82		13	77	
Pethidine	3		691 cc.	3		644 cc.
N_2O/	10	90		19	63	
Fluothane	4		804 cc.	11		664 cc.

Table II compares the blood loss occurring in "laminectomy and spinal fusion" first when fusion does not include the use of iliac bone and secondly when iliac bone is used. In this respect, cases of fusion, where a bone graft from the tibia is used, are included in the A columns of Table II, because the tibial graft is taken while using a tourniquet and entails no additional bleeding. Table II strongly suggests the superiority of epidural and combined epidural and general in all fusions.

Table III compares the case average measured blood loss in all types of operation. In operations lasting less than 2 hours, epidural block, subarachnoid block, and combined epidural and general gave better figures than general anaesthesia, while in operations lasting more than 2 hours and in all types and durations of operation, epidural gave decidedly lower blood loss figures.

TABLE III

CASE AVERAGE MEASURED BLOOD LOSS ALL OPERATIONS

Agent	No. of cases	A Less than 2 hours (cc.)	B More than 2 hours (cc.)	C All operations (cc.)	D Blood loss range (cc.)
Epidural	41	146	364	263	26–1,000
Subarachnoid block	10	143	821	414	34–1,664
Combined epidural and general	8	147	459	420	147– 880
N_2O/Pethidine	8	388	703	585	216– 998
N_2O/Fluothane	22	218	697	544	110–1,500

Table IV further subdivides the types and durations of operations. Here again there does not appear to be any significant difference in blood loss in "laminectomies only" taking less than 2 hours. In "laminectomies and spinal fusions" taking less than 2 hours, epidural block shows an appreciable advantage. In operations taking more than 2 hours and particularly when fusion is involved, epidural block is markedly superior.

Reference to Table V will show that the duration of operations taking longer than 2 hours was greatest in the N_2O/Fluothane series and consequently one would expect a greater case average blood loss in this group. However, Part 2 of Table V shows that the mean operating time for all types of procedures was highest in the combined epidural and general group, and this is only to be expected as already mentioned in the paragraph on case selection, because combined epidural and general anaesthesia was applied mainly to cases in which lengthy operative procedures were anticipated. The average blood loss per operating hour is again lower in the case of epidural and combined epidural and general, than in the other methods. Prolongation of the operating time in the N_2O/Fluothane group may well have been due to lack of an adequately dry surgical field.

Repeat Operations

In the more recent cases in which accurate blood loss measurements were made, twelve cases of "repeat" laminectomy or fusion occurred. The indications so far are that the blood loss is very much higher in these cases and that there is little to choose between one anaesthetic method and another where there is a lot of scar tissue.

Special Cases

Conjecture arose as to why there should be less bleeding with epidural block than with subarachnoid block. Bromage (4) states that the added adrenalin produces local vasoconstriction and cuts down local bleeding round about the epidural space. With this in mind, one patient in this series was given an epidural injection of 20 ml. of *saline* with 1:250,000 adrenalin, following which general anaesthesia was induced with Thiopentone followed by N_2O/O_2 and intravenous Pethidine. The patient remained normotensive throughout the procedure, and although there was brisk bleeding from the superficial tissues, the paravertebral

TABLE IV

ALL OPERATIONS

Agent	Operations lasting less than 2 hours						Operations longer than 2 hours					
	Laminectomy only			Laminectomy and spinal fusion			Laminectomy only			Laminectomy and spinal fusion		
	No. of cases	Percentage given blood or blood substitute	Average measured blood loss	No. of cases	Percentage given blood or blood substitute	Average measured blood loss	No. of cases	Percentage given blood or blood substitute	Average measured blood loss	No. of cases	Percentage given blood or blood substitute	Average measured blood loss
Epidural	28	0		26	13		9	11		30	46	
	13		152 cc.	7		138 cc.	8		315 cc.	13		394 cc.
Subarachnoid block	4	0		15	47		1	0		7	71	
	4		136 cc.	2		156 cc.	1		500 cc.	3		928 cc.
Combined epidural and general	5	0		7	43		1	0		16	50	
	0		—	1		147 cc.	0		—	7		459 cc.
N_2O/pethidine	1	0		8	62		1	0		16	88	
	1		216 cc.	2		474 cc.	1		458 cc.	4		764 cc.
N_2O/Fluothane	5	0		5	40		2	0		24	83	
	5		157 cc.	2		368 cc.	2		333 cc.	13		753 cc.

TABLE V

Agent	Operations lasting longer than 2 hours		All operations	
	Average duration of operation (hrs.)	Average blood per hour (cc.)	Average duration of operation (hrs.)	Average blood loss per hour (cc.)
Epidural	2.5	158	2.1	125
Subarachnoid block	2.75	337	1.6	259
Combined epidural and general	2.9	158	2.75	153
N_2O/Pethidine	2.75	278	2.3	254
N_2O/Fluothane	3.1	243	2.6	209

tissues were relatively dry. This would support the adrenalin local vasoconstriction theory. However, a second case undergoing laminectomy only, a procedure which was not anticipated to take longer than one hour, was given an epidural block using 20 ml. of Xylocaine *without adrenalin* and here the lowest blood loss figure of the whole series was recorded–26 ml. It is hoped to do further work along these lines.

Comparison of Blood Pressure Charts

The blood pressure charts of the cases done with epidural block, with subarachnoid block, with combined epidural and general, and with general anaesthesia alone using N_2O/Fluothane were fairly comparable. There was a mean drop in systolic blood pressure in these cases of 30 mm. mercury. The average case was maintained at a systolic pressure of 75 to 100 mm. mercury. In the cases done with N_2O/Pethidine, however, there was considerable variation from one case to the next. Some patients remained normotensive, some were maintained with small falls of systolic pressure, while others showed elevated pressures throughout the procedures. In this series, no constant relationship could be shown between degree of hypotension and amount of blood loss.

Complications

Table VI shows no significant complication difference among the methods. There were five recorded cases of postoperative urinary retention requiring catheterization in the epidural cases–almost a 5 per cent incidence–but this was transient only. Apart from this, the postoperative course was mainly uneventful and most patients experienced a minimum of upset from the operation. Respiratory and gastrointestinal disturbance incidence was low in the epidural cases. There was no significant difference in the amount of analgesic drugs required postoperatively, between one method and another.

NOTE. General anaesthesia combined with controlled hypotension using ganglionic blocking agents such as thiophanium camphorsulphonate (Arfonad) are now seldom used at this centre, because results with their use had been extremely variable, were often disappointing in the matter of providing a "dry" field, and also because with this method one case of cardiac arrest during spinal fusion had occurred in a healthy adult male.

TABLE VI

POSTOPERATIVE COMPLICATIONS

Agent	No. of cases	Minor respiratory	Major respiratory	Gastro-intestinal upset	Headache	Transient urinary retention	Wound haematoma	Other delayed healing	Deaths
Epidural	93	Nil	Nil	1	1*	5	1	1†	Nil
Subarachnoid block	27	1‡	Nil	3	1	1	2	1†	Nil
Combined epidural and general	29	1‡	1§	2	Nil	Nil	1	Nil	Nil
N_2O/ Pethidine	26	3‡	Nil	2	Nil	Nil	1	Nil	Nil
N_2O/ Fluothane	36	4‡	Nil	3	Nil	1	3	Nil	Nil

*Dura opened during surgery.
†Sero-sanguinous discharge lasting several days.
‡Mild sore throat or tracheal catarrh.
§Atelectasis and bronchopneumonia occurring in a bronchiectatic patient.

SUMMARY AND CONCLUSIONS

In a study of 211 cases of lumbar laminectomy and/or spinal fusion for correction of non-infective and non-malignant conditions, a comparison is made among various methods of anaesthesia and particularly with regard to blood loss and "dryness" of the surgical field. Epidural analgesia is considered a very satisfactory method for these operations, because of the relatively good operating conditions which it provides, together with minimal peroperative and postoperative upset to the patient. Its particular value lies in the fact that the depth of the surgical field remains relatively dry, thus ensuring an unobscured view of the more vital structures, and facilitating the approach to the diseased disk, as well as reducing the oozing of blood during spinal fusion. Its disadvantages lie mainly in the limited duration of its action and in the occasional technical difficulty in performing the block. It has not been shown in this series to possess any superiority to other methods, in providing a dry surgical field in repeat operations on the lumbar spine.

RÉSUMÉ

Cette étude se limite à l'anesthésie pour les opérations sur la colonne lombaire ou lombo-sacrée. Elle comprend les opérations visant à corriger les désordres des disques intervertébraux, de la mobilité articulaire anormale et des déformités comme le spondylolisthésis, sont exclues les excroissances et les infections.

Nous faisons une comparaison des résultats obtenus chez 200 malades avec l'épidurale, la rachianesthésie et l'anesthésie générale. En faisant cette comparaison, nous portons une attention spéciale au saignement dans le champ opératoire et à la quantité de sang perdu.

En comparant les quantités de sang perdu, nous en venons à la conclusion que, dans les cas où la laminectomie était la seule opération pratiquée, il n'y a pas de différence importante dans les pertes de sang avec les diverses méthodes, quoique, chez plusieurs cas d'épidurale, les chiffres fussent particulièrement bas.

Toutefois, chez les malades où la laminectomie a été suivie de fusion vertébrale,

les quantités les plus faibles de sang perdu ont été obtenus avec l'épidurale. Ce fait était particulièrement marqué, lorsque l'opération durait moins de deux heures. Lorsque l'opération se prolongeait de beaucoup au-delà de deux heures, chez les cas soumis à l'anesthésie épidurale, on observait une augmentation disproportionnée du saignement. L'induction de l'anesthésie générale, suivie de l'intubation endotrachéale, à la suite de l'anesthésie épidurale, a augmenté la perte sanguine de quantités dépassant celles des cas à l'épidurale seule.

La moyenne des pertes sanguines par cas a été moindre dans la série de cas faits à l'épidurale, plus considérable dans la série de cas faits avec N_2O, O_2 et Fluothane et intermédiaire dans la série de cas faits à l'épidurale et générale, à la rachianesthésie et au N_2O et O_2 et pethedine (Demerol). Mentionnons, toutefois, que, dans la série de cas faits au Fluothane, un petit nombre de cas seulement ont duré moins de deux heures et, dans les cas plus courts au Fluothane, les pertes sanguines étaient bien inférieures.

Nous n'avons pas noté de différences considérables dans les chiffres obtenus selon la position du malade: ventrale avec support ou autrement en position latérale.

L'épidurale: dans tous les cas, nous avons employé de la Xylocaine 2 pour cent avec adrénaline 1:300,000. Nous avons injecté une quantité standard de 20 ml. à L2–3 ou L3–4. Avec cette quantité, nous avons observé une variation considérable dans la hauteur de l'analgésie obtenue. Chez deux malades, l'analgésie ne s'est pas étendue au-dessus du site de l'injection, bien que, au-dessous, elle fût adéquate. Dans un cas, l'analgésie était inégale au-dessous du dermatome L3 bien qu'elle fut adéquate au-dessus de ce niveau. Chez tous les autres malades, l'analgésie s'est étendue de façon satisfaisante. Avant l'induction, nous n'avons pas injecté de routine d'hypertenseurs et rarement nous y avons eu recours après l'installation de l'analgésie même chez les malades où elle a atteint le niveau de T3. Nous n'avons pas observé de cas d'hypotension marquée. La durée de l'analgésie a varié entre 2½ heures et 4 heures, la moyenne étant de 3 heures. La plupart des malades ont reçu des quantités anesthésiques de Nembutal et/ou de thiopentone (Pentothal) et, dans les cas qui se prolongeaient et où l'analgésie disparaissait, l'on complétait par de la pethedine (Demerol) intraveineuse soit en doses fractionnées, soit en goutte-à-goutte. Chez aucun malade, l'on a dû installer un tube. L'évolution post-opératoire a été sans incident chez la plupart des cas.

S'il n'y a pas présence d'infection ou de malignité, l'épidurale s'est avérée une méthode d'anesthésie satisfaisante pour les opérations sur la colonne lombaire. Elle procure, dans la grande majorité des cas, de bonnes conditions opératoires.

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DOUBLE BLIND STUDY OF PHENOTHIAZINES USED IN PRE-ANAESTHETIC MEDICATION: A CLINICAL EVALUATION OF PROMETHAZINE (PHENERGAN®), PROMAZINE (SPARINE®), PROCLORPERAZINE (STEMETIL®), AND LEVOMEPROMAZINE (NOZINAN®)

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A CONTROLLED EVALUATION of the effect of pre-anaesthetic medication was carried out with a standard series consisting of promethazine and atropine, and a double blind series consisting of four phenothiazine derivates, and a placebo, each of which was combined with scopolamine. The four drugs that were tested were selected on the basis of previous clinical experience which seemed to indicate that these drugs were the most likely to prove valuable as premedicants from among the wide range of phenothiazine derivatives now available (1, 2).

METHOD

The drugs and the placebo were dispensed in identical vials which were identified to the participants in the study only by code letters. The oral preparations were similarly coded. The oral placebo was a capsule containing lactose and the placebo solution for injection was normal saline. The volume of estimated "equipotent" doses was noted on the labels. Premedication was ordered by the anaesthetist using the code letters which could be identified with the actual drugs only by the hospital pharmacist. The standard (promethazine and atropine) could not be identified with its unknown counterpart (promethazine and scopolamine), because a different test drug was assigned to each anaesthesia resident, and the assignments *and* codes were changed at intervals. Scopolamine was combined with each unknown to augment the difficulty in identifying the unknowns, and to assure a satisfactory anti-sialogogue effect, because all phenothiazines are not potent in this respect (3).

The study was limited to adult patients who were in physical status 1 or 2, and who were to have an elective operation. Patients in the extremes of age (under 19 and over 65 years) and those for intracranial, cardiopulmonary, and short minor operations were excluded from the study. For these reasons, the dose of each test drug was not varied unless the patient was extremely nervous or of very large size. A protocol was not initiated if premedication was given less than 30 min. or more than two hours from the induction of anaesthesia. These measures were adopted in order to achieve a more reliable basis for over-all comparison of the premedicant drugs. The protocol sheet that is shown in Figure 1 was

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PREMEDICATION STUDY

Purpose of Admission : Age : _____ Ht. : _____
Operation : Sex : _____ Wt. : _____
Date of Operation :
DRUG CODE :
Dose : Night before : Code _____ mg. orally.
Seconal
One hour pre-induction _____ mg. i.m.
Atrop. / Scop. Dose : _____ mg. With premed./time :
Route :

Assessment

1. Time H. S. of administering drug : _____
2. Time of onset of sleep : _____
3. Sleeping drug usually taken : _____
4. Pre-drug assessment : (1) Very nervous (2) Normal (3) Stable
5. Thyrotoxicity : Present Past
Degree : mild severe

Pre-induction Questions :

1.	Are you comfortable ?	yes	no
2.	Are you worried ?	yes	no
3.	Are you tense ?	yes	no
4.	Are you unusually happy ?	yes	no
5.	Are you unusually sleepy ?	yes	no
6.	Is your stomach upset ?	yes	no
7.	Did you vomit ?	yes	no
8.	Do you feel tired ?	yes	no
9.	Do you see double ?	yes	no
10.	Any complaints ?	yes	no

(circle appropriate items)

Anaesthetist's Own Impression

Was the patient :

1.	comfortable	uncomfortable
2.	worried apprehensive	untroubled
3.	excited	relaxed
4.	happy euphoric	serene
5.	drowsy sleepy	wide awake
6.	talkative	quiet
7.	nauseated	
8.	able to raise eyelids	
9.	able to hand grip firmly	

Anaesthetist's Report

1. Vital Signs :
   a. Admission : B. P. _____ Pulse _____ Resp. _____ Oral T° F _____
   b. Pre-sedation : B. P. _____ Pulse _____ Resp. _____ Oral T° F _____
   c. Pre-induction : B.P. _____ Pulse _____ Resp. _____ Pupil Size _____
2. Tidal Volume : Pre-sedation _____ ml. Pre-induction _____ ml.
3. Time in minutes between i.m. drug and induction : _____
4. Character of induction : Smooth _____ Smooth but slow _____
   Difficult _____ Stormy _____
   Excessive secretions _____
5. Induction agent : Amount :
6. Anaesthetic technique :
7. Anaesthetist's estimation of adequacy of premedication :
   Adequate _____ Inadequate _____ Excessive _____

Post-operation Questions :

What do you remember happening just prior to your operation ?
1. I. M. injection ?
2. Trip to Operating Room ?
3. Movement to operating table ?
4. Was induction pleasant unpleasant indifferent or unknown

Post-operative report :

1. Amnesia _____
2. Urinary retention (Did the patient have to be catheterized within 10 hours of operation ?) _____
3. Shivering _____ _____
4. Hypotension - after induction _____
   post-operative _____
5. Nausea and vomiting post-operative _____
6. Delay in "awakening" after completion of operation _____ (from Recovery Room notes).
   (minutes)
7. REMARKS :

FIGURE 1. Protocol for premedication evaluation.

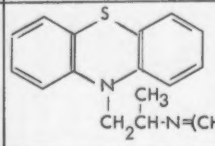
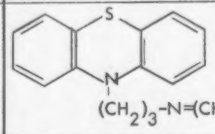
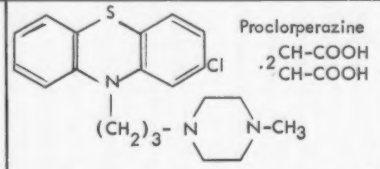
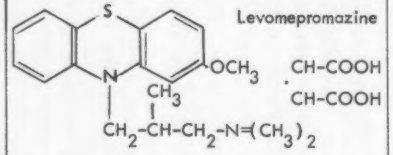
DRUGS	OFFICIAL NAME & STRUCTURAL FORMULA	ORAL MEDICATION at H.S.	INTRAMUSCULAR MEDICATION ONE HOUR BEFORE ANAESTHESIA
PHENERGAN ATROPINE	 Promethazine .HCl	50 mg. +SECONAL 100 mg.	25 mg. 0.6 mg.
PLACEBO SCOPOLAMINE		LACTOSE +SECONAL 100 mg.	NORMAL SALINE 0.4 mg.
SPARINE SCOPOLAMINE	 Promazine .HCl	50 mg. +SECONAL 100 mg.	25 mg. 0.4 mg.
STEMETIL SCOPOLAMINE	 Proclorperazine .2 CH-COOH CH-COOH	10 mg. +SECONAL 100 mg.	5 mg. 0.4 mg.
NOZINAN SCOPOLAMINE	 Levomepromazine . CH-COOH CH-COOH	25mg. +SECONAL 100 mg.	15 mg. 0.4 mg.
PHENERGAN SCOPOLAMINE		50 mg. +SECONAL 100 mg.	25 mg. 0.4 mg.

FIGURE 2. Route and dose of drugs used for premedication.

initiated and completed on 772 patients. The dose of each drug that was ordered is listed in Figure 2.

General anaesthesia was started with a sleep dose of intravenous thiopental in every case in order to assure a quiet induction. Maintenance of anaesthesia was left to the discretion of the anaesthetists, most of whom used cyclopropane or nitrous oxide with trichlorethylene or ether. No supplements of the test drugs or related phenothiazine derivatives were given to any of these patients during anaesthesia. In the postoperative period, those patients who vomited were given perphenazine (Trilafon®) (4). The code in this study was not revealed until the data on each patient's chart and protocol were completely abstracted, tabulated, and analysed.

It was realized at the outset that it was not possible to distinguish reliably between the feelings expressed by the patient in answering the ten direct questions, and the opinions noted in the anaesthetist's own impression of the patient's mental state. Therefore, in analysing the data, the greatest weight was given to the statements made by the patient when he made complaints, because we felt that it was unfair to conclude at any time that an individual was not apprehensive when the direct answers by the patient indicated that he was tense or worried. On the other hand, the anaesthetist's impression was given more weight when the patient showed a variety of signs and symptoms that appeared sufficient to indicate that the patient was apprehensive although he might have answered that everything was satisfactory. In other words, the analysis of the data from that part of the protocol which contained the subjective and objective assertions were weighted to indicate that the patient was apprehensive whenever there was any indication of this. In addition, the anaesthetist also noted whether he considered the premedication was adequate, inadequate, or excessive, using the usual criterion for adequacy: a quiet patient who is drowsy or moderately sleepy, but can be roused easily, and has suppression of salivary secretions.

Results

Tables I, II, and III contain a summary of the pertinent data from the 772 patients on whom information was complete.

In each test drug series there were more females than males. The variation in the number of females among these did not appear to affect the observations that were analysed.

Effect on Inducing Sound Sleep (Table I)

The combination of secobarbital with promazine and with levomepromazine provided the most satisfactory conditions for sound sleep.

Effect on Psychic Preparation (Table I)

In the anaesthetist's evaluation of the premedication, the placebo and the standard groups were the only ones that did not have at least 85 per cent of the patients well prepared. If the standard (promethazine-atropine) is compared with the agents used in the blind study, it is evident that scopolamine provided a significant sedative effect. From the subjective and objective answers, levome-

TABLE I

PRE-ANAESTHETIC EVALUATION OF PREMEDICATION

Drugs	Number of patients	Females (%)	Delayed or unsatisfactory sleep (%)	Anaesthetists' evaluation of premedication			Subjective and objective evaluation of premedication		
				Adequate (%)	Inadequate (%)	Excessive (%)	Apprehensive (%)	Nauseated (%)	Drowsy-sleepy (%)
Promethazine Atropine (Standard)	129	64	8	81	19	0	42	2	48
Placebo Scopolamine	119	57	10	84	16	0	27	0	59
Promazine Scopolamine	143	59	2	95	3	2	21	2	78
Proclorperazine Scopolamine	168	71	8	88	12	0	29	3	55
Levomepromazine Scopolamine	71	62	3	92	2	6	12	0	90
Promethazine Scopolamine	142	72	6	89	10	1	30	1	60

TABLE II

EFFECT OF PRE-ANAESTHETIC MEDICATION ON VITAL SIGNS

Drugs	Before induction						After induction hypotension >20% (%)
	Hypotension >15% (%)	Hypertension >15% (%)	Bradycardia >15% (%)	Tachycardia >15% (%)	Bradypnoea >20% (%)	Tachypnoea >20% (%)	
Promethazine Atropine (Standard)	19	23	13	44	4	34	7
Placebo Scopolamine	42	16	42	37	7	13	9
Promazine Scopolamine	43	10	23	35	3	20	21
Proclorperazine Scopolamine	60	5	48	18	2	44	11
Levomepromazine Scopolamine	38	12	24	30	24	14	6
Promethazine Scopolamine	28	19	30	26	9	12	14

TABLE III

POSTOPERATIVE EVALUATION OF PATIENTS

Drugs	Hypotension >20% (%)	Nausea and Vomiting (%)	Delay in recovery of consciousness (mins.)	Amnesia (%)	Shivering (%)	Urinary retension 10 hours (%)
Promethazine Atropine (Standard)	12	20	28	8	7	12
Placebo scopolamine	10	21	33	8	13	4
Promazine scopolamine	17	17	55	7	11	4
Proclorperazine scopolamine	11	15	46	7	12	3
Levomepromazine scopolamine	20	9	53	24	8	3
Promethazine scopolamine	19	17	45	13	8	7

promazine caused the greatest incidence of drowsy or sleepy patients, and also appeared to suppress apprehension to the greatest degree.

Effect of Premedication on Vital Signs (Table II)

Hypertension and tachycardia occurred more often in the standard test than with any of the blind tests. Hypotension and bradycardia occurred most often with proclorperazine-scopolamine. There was no significant difference among the agents (except proclorperazine) with respect to the incidence of tachycardia. Hypotension occurred less frequently with promethazine—both in the standard and in the blind test. It was interesting to observe that the incidence of hypotension in the placebo group was higher than in both promethazine groups.

The determination of tidal volumes was abandoned early in this study because the application of the face mask of the ventilation meter in the immediate preoperative period was unpleasant to the patient, so that only respiratory rates were recorded thereafter. A slower respiratory rate was observed most often with levomepromazine. Tachypnoea was observed most often with proclorperazine.

After induction of anaesthesia, hypotension occurred most often with promazine. There were no cases of profound hypotension, but at least 20 per cent reduction in blood pressure was observed in more than 5 per cent of the patients in each group.

Postoperative Condition of the Patients (Table III)

Hypotension was observed in at least 10 per cent of the patients in all groups. It occurred least often in the patients who were premedicated with the placebo. However, it is difficult to equate postoperative hypotension with the premedicants without detailed consideration of the wide variety of factors of each anaesthetic course. Nausea and vomiting occurred postoperatively in approximately 20 per cent of patients in the standard series and with the placebo. The least incidence of nausea and vomiting was in the patients who received levomepromazine, but the difference from the other groups was not great.

There are numerous factors that may cause prolonged postoperative "sleep" even though each anaesthetist strives to have his patients aroused shortly after the end of an operation. On the average, the patients slept significantly more than half an hour if they received scopolamine with any of the phenothiazine derivatives. The longest sleep was seen with promazine and levomepromazine.

The occurrence of amnesia related to the period extending from the administration of the pre-anaesthetic medication until postoperative recovery of consciousness was recorded in at least 7 per cent of the patients in each series. The greatest incidence of amnesia was recorded for the patients who received levomepromazine. This might reflect the greater number of patients who were drowsy or sleepy, but amnesia was not a characteristic of the patients who received promazine, even though most of these patients were sleepy preoperatively and slept longer postoperatively.

The occurrence of postoperative shivering and urinary retention did not show any significant variation among the groups that could be related directly to the premedicants.

Discussion

In every branch of medicine, the student is informed that the initial approach to his patients and his explanation of the physical and mental complaints may contribute as much to ultimate cure as any specific therapeutic measures. The effect of his personality and the acquired ability of the physician to reassure and to calm those who are fearful are particularly important attributes of the anaesthetist. Few of us have this ability. Most physicians will always depend mainly on the aid of drugs to subdue apprehension (5, 6, 16).

The greatest problem which faces the anaesthetist who strives to suppress emotional stress is how to evaluate the effect of drug therapy. From previous

discussions of this problem (7, 8), one aspect requires further consideration: most anaesthetists overestimate their ability to diagnose functional disorders. Often, even in ordinary life situations, we are unable to distinguish the fearful and anxious who have a "dead pan" or a "poker face" from the really composed and tranquil stranger, without the use of searching questions and "cross examination." For instance, when a stoical woman is being prepared for removal of a painless lump in her breast which might be carcinomatous, can we identify easily her emotional stress? Can we differentiate that from the physical and mental stress that might develop when she was about to have a painful ingrown toenail excised? Furthermore, do we have a certain method for differentiating the tranquillity that might be caused by morphine from that by promethazine in these two situations? Only those who have no difficulty with these questions can decide on the correct drugs to choose for use in premedication.

The valid arguments for disuse and use of narcotics (9, 10) and barbiturates (11) as premedicants in anaesthesia apply equally well to the use of ataractics (1, 12). For that matter, it appears evident to each experienced anaesthetist that he can usually provide satisfactory pre-anaesthetic sedation, without serious physiological upset to the patient, with many different drugs, even though their mode of action may vary widely (2, 13).

In designing this clinical experiment, every effort was exercised to make the evaluation as sensitive as possible (14, 15). The subjective and objective questionnaire was used to reveal physical and mental signs and symptoms, and the over-all evaluation of the premedicant effect was noted also for the wider perspective. Both placebo control and double-blind control were employed to protect against bias and psychic factors which cannot be eliminated, and to protect against spurious data. An "internal control" was employed by the use of a standard which was identical with one of the unknown drugs, to provide a competent indicator of positive effects, and to determine how much the anti-sialogogue (scopolamine) might contribute to the various aspects of premedication that were being studied.

The development of drowsiness or sleepiness may not be the only condition for allaying anxiety and fear, but it is often true that the sleepy patient is less apprehensive than the patient who is wide awake, and acutely aware of his environment. It appears, therefore, that part of the success of a pre-anaesthetic sedative in suppressing apprehension depends in some measure on its hypnotic effect. The other important attribute of such a drug is its ability to produce a period of amnesia. These attributes must be weighed against the occurrence of marked hypotension during induction of anaesthesia, and delayed post-anaesthetic recovery of consciousness.

From this study, one may be able to decide: Does it pay to add a phenothiazine to a barbiturate to reduce the incidence of unsatisfactory preoperative sleep by at least 5 per cent, and does it pay to use a phenothiazine with scopolamine to reduce pre-anaesthetic apprehension, reduce postoperative nausea and vomiting, and increase the incidence of amnesia for the operative period, without serious disturbance of the patient's vital signs (16)?

Considering all these, one is seldom justified in using a placebo for preoperative sedation. Proclorperazine may not be worthy of further trial because its hypnotic,

amnesic, anti-emetic, and tranquillizing actions were not good at a dose level that frequently caused hypotension. Promazine appeared to have a good hypnotic activity, but it was a weak anti-emetic and amnesic, hypotension occurred too frequently after induction of anaesthesia, and post-anaesthetic sleep was much prolonged. Levomepromazine was an excellent hypnotic and had a good anti-emetic and amnesic activity, but prolonged post-anaesthetic sleep was common. The discriminate use of levomepromazine is worthy of further trial at slightly reduced dosage from that tested here. An increase in the dosage of promethazine (combined with scopolamine) might improve its activity without depressing vital signs, but in this study its over-all performance was not as good as levomepromazine and promazine.

Summary and Conclusions

Pre-anaesthetic medication with promethazine, promazine, proclorperazine, and levomepromazine was studied under controlled clinical conditions employing the double blind method with a placebo, and a known standard. The test drugs were combined with secobarbital and administered by mouth the night before an elective operation to determine their effectiveness for inducing undisturbed sleep. Approximately one hour before induction of anaesthesia, each patient received an intramuscular injection of the same test drug, combined with scopolamine in the blind study or promethazine with atropine in the standard study. Data were collected on a special protocol. This contained information recorded from the initial visit, before induction of anaesthesia, in the post-anaesthetic recovery room, and 24 hours postoperatively. On completion of the study, these data were tabulated and analysed *before revealing the code.* Analysis of the data showed whether the administered drugs disturbed the vital signs, allayed apprehension, induced light sleep or caused amnesia. The data from each series of drug tests were compared. In this study, levomepromazine was the most effective premedicant without causing any more undesirable effects than were seen among the others.

It appears as if the "price" we pay for tranquillity should depend partly on the pharmaceutical industry and on the skill exercised by the anaesthetists who use their drugs, just as it does for our primary anaesthetics. The greatest value from individual drugs—whether they are narcotics, barbiturates, phenothiazines, or other ataractics—will depend ultimately on the ability of the individual anaesthetist to prepare the patient by his own personal approach, and by his considered and experienced selection from a wide range of drugs. The greatest emphasis should be placed on the individual selection of a drug in relation to the age, size, temperament and physical state of the patient.

Acknowledgment

The drugs used in this study were supplied by Poulenc, Ltd., of Montreal, and by John Wyeth & Brother (Canada) Limited, of Walkerville, Ontario. The drugs were coded by the Pharmacy in the University Hospital, Saskatoon.

Résumé

Dans des conditions cliniques contrôlées et en employant la méthode du "double inconnu" avec un placebo et un standard connu, nous avons étudié la médication préanesthésique avec de la prométhazine, de la promazine, de la proclorperazine et de la levomepromazine. Nous avons associé le médicament à étudier à du secobarbital que nous donnions, par la bouche, la veille d'une opération élective, pour bien préciser leur pouvoir d'induction calme du sommeil. Environ une heure avant l'induction de l'anesthésie, chacun des malades recevait une injection intra-musculaire du même médicament à étudier avec de la scopolamine pour l'étude avec l'inconnu ou avec de la promethazine et de l'atropine pour l'étude standard. Les données ont été colligées sur un protocole spécial. Ce protocole contenait les renseignements obtenus dès la première visite, avant l'induction de l'anesthésie, dans la salle de réveil après l'anesthésie et, enfin 24 heures après l'opération. A la fin de l'étude, les données ont été mises en tableaux et analysées avant de révéler la légende. L'analyse des résultats devait montrer si les médicaments donnés modifiaient les signes vitaux, faisaient disparaître l'appréhension, provoquaient un léger sommeil ou entraînaient de l'amnésie. Nous avons comparé les données de chaque série de médicaments. Après cette étude, nous sommes d'avis que la levomepromazine a été la médication la plus efficace sans pour cela entraîner plus d'effets indésirables qu'aucun des autres médicaments.

Il nous semble que le tribut à payer pour assurer notre paix dans ce domaine doit aller en partie à l'industrie pharmaceutique et en partie à la capacité des anesthésistes qui emploient ces médicaments, comme il en est d'ailleurs pour les anesthésiques de base. La plus grande vertu de tout médicament—qu'il s'agisse de narcotiques, de barbituriques, de phenothiazines ou d'autres ataraxiques—va dépendre en définitive de l'habileté de l'anesthésiste, comme individu, qui prépare le malade, par son contact personnel et par le choix judicieux et bien informé d'un médicament entre plusieurs. Il faut insister beaucoup sur le choix particulier de chacun des médicaments selon l'âge, le poids, le tempérament et l'état physique du malade.

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ANAESTHESIA FOR LIGATION OF PATENT DUCTUS ARTERIOSUS IN CHILDREN

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A patent ductus arteriosus is the second most common lesion in congenital heart disease (1). Its incidence in the general population has been estimated to be between 1:2,500 and 1:5,000 by one author (2), and 1:3,850 by others (3). Surgical ligation of a persistent ductus was first carried out by Gross in 1939 (4). At present, it is probably the most frequently performed cardiovascular operation. Anaesthesia for this procedure is simple in the usual case but the presence of complicating factors adds considerably to the risk of the operation. Those patients requiring ligation during infancy and those with increased pulmonary vascular resistance present the most serious problems. This paper deals with 104 consecutive paediatric cases which were diagnosed as patent ductus arteriosus and came to operation.

Pathological Physiology

The ductus arteriosus is an arterial channel connecting the left pulmonary artery to the ventral-lateral surface of the aorta, close to the origin of the left subclavian artery. The ductus may vary considerably in length, width, shape, and thickness. In foetal life, blood flows from pulmonary artery to aorta, but at birth it reverses direction. The flow through the ductus may increase the pulmonary circulation to two to four times that of the systemic system and cause pulmonary hypertension.

With large shunts, the increased pulmonary venous return produces left atrial and left ventricular hypertrophy. The left ventricle may fail, and this can occur even in infancy; it may then result in right ventricular failure. The ductus may undergo aneurysmal changes or become the site of bacterial endocarditis. In addition, because so much blood is passing through the pulmonary system, the general development of the child may be seriously retarded.

A serious complication is increased pulmonary vascular resistance with severe pulmonary hypertension. This leads to a reversal of flow and subsequent development of right heart failure. If ligation of the ductus is performed at this stage, death may occur promptly owing to closure of the "escape" route of the pulmonary circuit. The cause of this condition is not known, but the degree of pulmonary hypertension, the volume flow through the ductus, the extent of pulmonary vasoconstriction, and individual variation are all factors.

Prognosis

The average age of death was 35 to 38 years in a group of 60 patients with persistent ductus who survived to adolescence and were untreated. It was estimated that when untreated patients reached the age of 17 years, they have only half the normal life expectancy (5).

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Surgical treatment of the uncomplicated case carries a very low mortality; 0 in 108 cases (6), 0 in 116 cases (7), 0 in 300 cases (8), 3 in 138 cases (9), and 10 in 482 cases (10). If persistent ductus is associated with pulmonary hypertension, there is an 18 per cent operative mortality and, if a marked right to left shunt exists, the operative mortality is 56 per cent (11). In a world survey of surgical treatment of 2,929 children under 14 years with patent ductus, the mortality was 2.3 per cent (12).

If cardiac failure occurs in infancy, operation should be performed promptly (3, 15). In uncomplicated cases, operation may be postponed to 3 or 4 years of age (3, 13). After the age of 5 years the incidence of complications rises sharply (14).

The presence of pulmonary hypertension with increased vascular resistance is the principal contraindication to operation (16).

Anaesthesia

In this series, there was a total of 104 children, ranging in age from 3 weeks to 15 years. They are grouped according to age in Table I. The preoperative complications consisted of cardiac failure, pulmonary hypertension, failure to thrive, or repeated respiratory infections. All children were labelled patent ductus and were anaesthetized for ligation of the lesion. Various agents and techniques were employed, but the following anaesthetic management was preferred.

TABLE I

	No. of cases	Complications	Deaths
Males			
Birth–12 mos.	5	5	2
12–24 mos.	5	2	0
2–8 yrs.	16	14	0
9–15 yrs.	7	2	0
Total	33		
Females			
Birth–12 mos.	14	11	3
12–24 mos.	6	3	0
2–8 yrs.	41	4	0
9–15 yrs.	10	1	0
Total	71		

Preoperative Visit

The anaesthetist must thoroughly examine the patient preoperatively Complicating illness not due to the cardiovascular lesion results in cancellation of operation. The cardiovascular system is examined in detail. The typical patient has a precordial heave and thrill with a continuous "machinery" murmur in the pulmonary area. The ECG shows left ventricular hypertrophy and there may be minimal cardiomegaly as shown by chest X-ray. The atypical patient with increased pulmonary resistance may have such symptoms and signs as dyspnoea, chest pain or cyanosis, a systolic murmur only, and a markedly increased

pulmonary second sound. The ECG shows combined or right ventricular hypertrophy, and chest X-ray may show an increased heart shadow.

Premedication consists of meperidine (0.75 mg./lb.) and atropine (.012 mg./lb.). Morphine is used in older patients in a dosage of 1 mg./10 lb. body weight. Sedation is minimal, as apprehension is rarely a prominent feature and drug depression must be avoided. In the infant with failure, atropine is given immediately preceding anaesthesia to avoid increasing the heart rate and the degree of failure.

Induction

In the older child a "sleep" dose of 2½ per cent thiopentone is administered slowly followed by succinylcholine (1 mg./3 lb.). With the onset of complete relaxation and following adequate ventilation, the larynx is sprayed with 2 per cent lignocaine. The patient is intubated and artificially ventilated with nitrous oxide-oxygen mixture (60:40) until spontaneous respirations return, when halothane is added. An 18-gauge needle with stylet is inserted in the right saphenous vein as a "spare" entrance to a vein. A cut-down is started after induction to avoid undue disturbance of the child.

In the infant, intramuscular succinylcholine (2 mg. lb.) is used while nitrous oxide–oxygen–halothane is administered. The intramuscular dose may have to be repeated until the cut-down is functioning.

Maintenance

Nitrous oxide–oxygen–halothane mixtures is the anaesthetic of choice, supplemented by intermittent succinylcholine. Hyperventilation is begun as the chest is opened and is maintained throughout the operative period. Blood loss is carefully calculated and accurate replacement is made.

Monitoring

The heart sounds are monitored using an oesophageal stethoscope. On closure of the ductus, the diastolic component of the murmur should always disappear. The systolic component frequently persists but is usually without significance.

The blood pressure is monitored using a Collins oscillometer. Following ligation, the diastolic blood pressure rises in the typical patient. In those patients with small flows through the ductus there may be no detectable rise in diastolic pressure. The effect of ligation on systolic blood pressure is variable.

The ECG, EEG, and rectal temperature are monitored routinely.

In selected patients, monitoring of the pulmonary arterial (PA) pressure may be carried out. Those patients with typical patent ductus show no change in PA pressure when their ductus is temporarily occluded (see Fig. 1). If the PA pressure falls in patients with pulmonary hypertension, then the degree of increased resistance is minimal and the ductus may be ligated in safety. If the PA pressure is unaltered or rises in patients with severe pulmonary hypertension (see Fig. 2), then the degree of increased resistance is marked and ligation of the ductus carries a high mortality.

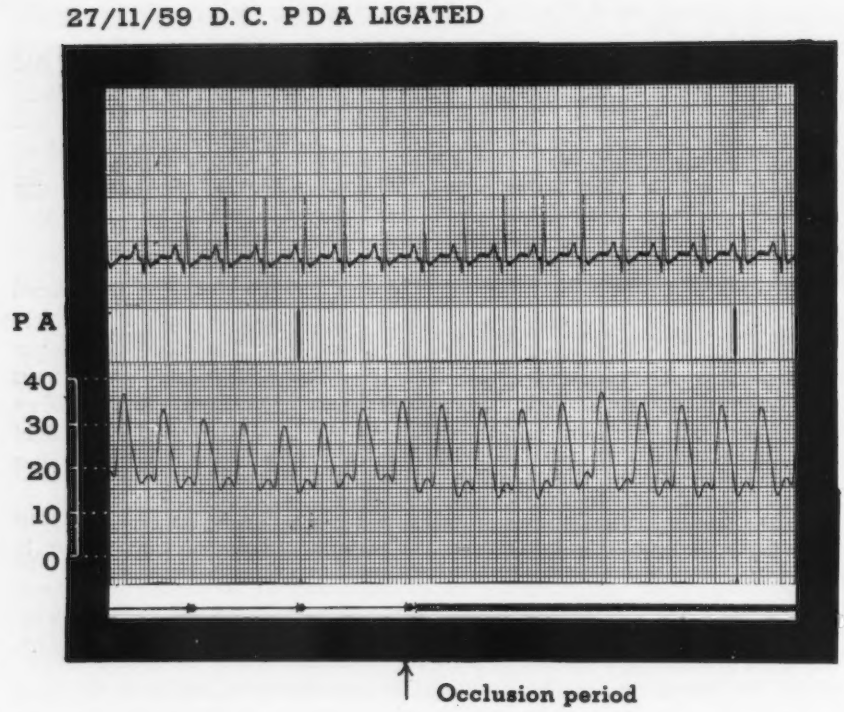

FIGURE 1

Recovery

The operative time averages 1½ hours and the patient is awake before leaving the operating room. He is taken to the recovery room and remains there for a minimum of 4 hours for close observation. Meperidine (1 mg./10 lb.) intravenously is used for sedation and repeated as necessary. No oxygen tent is used and blood replacement is rarely necessary.

COMPLICATIONS

After hospital discharge follow-up records were not completed on every patient. However, the known complications are listed. There were 5 deaths in this series with the following post-mortem findings:

(1) Age 3 weeks: Ligated PDA, patent foramen ovale (PFO), total anomalous pulmonary venous drainage, repaired diaphragmatic hernia, bilateral bifid ureters and pneumothorax
(2) Age 3 months: Ligated PDA, preductal co-arctation, ventricular septal defect, PFO, congestive heart failure and pulmonary atelectasis
(3) Age 3 months: Ligated PDA, A-P window, PFO, bronchopneumonia

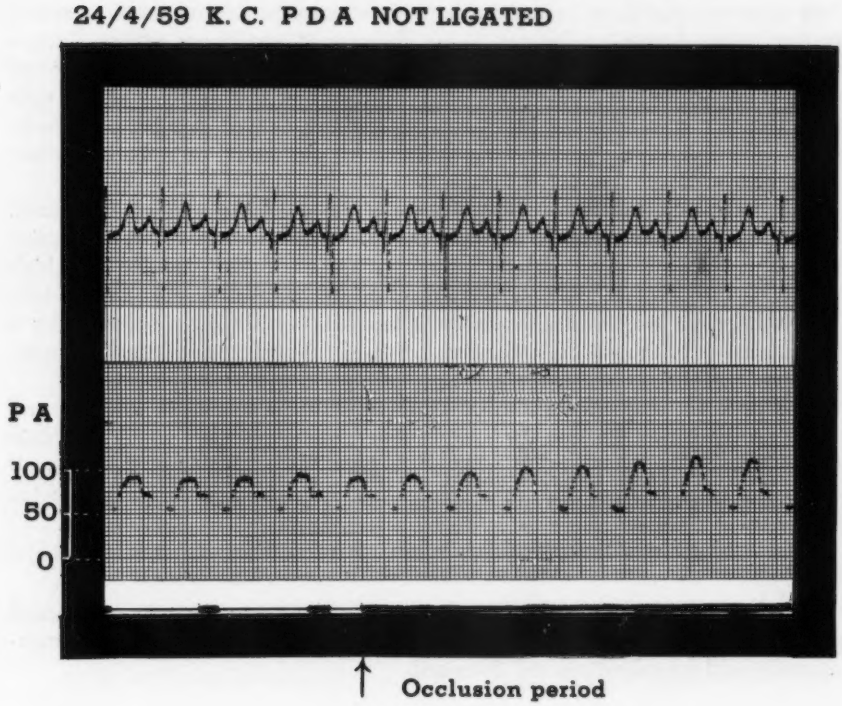

FIGURE 2

(4) Age 6 months: Ligated PDA, repaired ventricular septal defect (pulmonary artery opened for A-P window but ventricular defect found instead and repaired through pulmonary valve)
(5) Age 7 months: Ligated PDA, ventricular septal defect, PFO, and gross cardiomegaly

In the remainder of the series, the lesser complications are given below:

(1) *Pulmonary* (pleural effusion 1, surgical emphysema 1, small tear in lung 1, excessive secretions 1, bronchial stenosis requiring tracheotomy 1)
(2) *Neurogenic* (phrenic paralysis 1, transient recurrent laryngeal nerve paralysis 1, transient brachial plexis injury 1)
(3) *Cardiovascular* (no ligation because of (*a*) increased vascular resistance 1, (*b*) A-P window instead of PDA, incomplete closure 1)

DISCUSSION

The preceding data are similar to those found by other cardiovascular units. They emphasize features of great importance in patients with persistent ductus arteriosus. These are (*a*) age at operation and (*b*) the presence of complicating factors.

It is known that some infants with patent ductus arteriosus develop severe cardiac failure during the first year of life. Between 20 and 25 per cent of children with isolated patent ductus die in infancy, but all could be saved with prompt medical and surgical treatment (15). It is also evident that many children with patent ductus have additional cardiovascular lesions as well as other abnormalities. The operative risks are considerable but with specialized care, many of these could be saved.

The presence of increased pulmonary resistance carries a grave prognosis. Pulmonary hypertension alone increases the risk of operation (11). The operative mortality is prohibitive in those patients with severe hypertension and high resistance (11, 17). In patients with reversed or largely reversed shunts who have a hopeless prognosis otherwise, it is justifiable to do a thoracotomy for a trial occlusion of the ductus with observation of the pulmonary artery pressure changes.

It is probable that with increased duration of high pulmonary pressure and arteriolar resistance, irreversible changes may eventually occur which maintain the pulmonary hypertension, in spite of surgery (18). Therefore, the facts all argue for surgical treatment at an early age in patients with patent ductus arteriosus.

Summary

This paper deals with a total of 104 cases which came to operation diagnosed as patent ductus arteriosus. The pathological disturbances, the anaesthetic management, and complications are discussed.

Résumé

Ce travail contient l'étude de 104 cas de cardiopathie dirigés vers la chirurgie avec le diagnostic provisoire de persistence du canal artériel. Les troubles physiopathologiques, la conduite de l'anesthésie et les complications sont discutés.

Acknowledgments

Thanks are extended to Dr. W. T. Mustard and Dr. G. A. Trusler for permission to review these cases.

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ATARACTICS AND THE RECOVERY ROOM, WITH REFERENCE TO TRIFLUPROMAZINE, I

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During the last few years numerous drugs with tranquillizing properties have been synthesized and these are referred to, collectively, as ataractics. Composing one group of these are the phenothiazine derivatives and the use of one or other of these in the anaesthetic technique has sometimes been advocated. The specific value of the tranquillization produced by these drugs has not yet been established and the occurrence of complications such as tachycardia, hypotension, jaundice, and extra-pyramidal reactions has led at least one authority to question the use in anaesthesia of any drug currently available in this class (1). These drugs have in common sedative and anti-emetic effects. Under certain circumstances it is especially desirable to avoid emergence vomiting and restlessness in the immediate post-anaesthetic period. The potential damage due to these complications may be considered under two headings. First, the patient's life may be endangered by them. Splinting of the jaw or immobilization in cast or respirator, for example, makes vomiting hazardous, and coronary arterial insufficiency is increased by mental stress (2) and hypotension. The former can be produced by the recovery of consciousness in unusual surroundings and the latter by nausea and retching (3); consequently, patients suffering from this disease who have also been subjected to surgical trauma should be protected from these complications. Secondly, the operative site may be damaged. This damage is particularly apt to occur after plastic and ophthalmic surgery or if the patient is mentally disturbed.

Trifluprομazine (Vesprin: Squibb) is a phenothiazine derivative for which potent tranquillizing and anti-emetic properties have been demonstrated, and its use as prophylactic against these complications is now described.

Method

Trifluprομazine was administered intravenously in increments of 1 to 4 mg. depending on the weight and physical state of the patient at intervals of 2 or 3 min. during the half-hour prior to the termination of general anaesthesia. The total dosage used depended on the effect of the premedication, anaesthetic requirements, and response to the initial dose of the drug. It varied between 0.1 and 1.0 mg./10 lb. body weight. The incidence of emergence vomiting and restlessness was observed critically in the recovery room.

Results

Details of patients, dosage used, emergence vomiting and/or restlessness, and alterations in systolic blood pressure are recorded in Table I. The diastolic pressure showed a trend similar to the systolic while the pulse rate was usually un-

TABLE I

	Dosage (mg./10 lb. body weight)									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Total number of cases	3	2	13	12	10	20	13	10	4	4
Number of cases suffering from emergence vomit or restlessness	0	2	2	1	1	3	1	1	1	1
Number of cases with hypertension or known coronary arterial disease	3	1	6	5	4	5	3	1	0	0
Mean fall in the systolic arterial pressure, (mm./Hg)	37.0	2.5	11.0	10.0	7.0	8.0	9.0	6.0	7.5	5.0
Distribution of fall in systolic blood pressure	30–40	0–5	0–30	0–20	0–20	0–30	0–30	0–20	0–10	0–10

changed or slightly increased. The muscle tone of the patients was good and no extra nursing care was required. In some cases the recovery of consciousness seemed delayed, but this was not necessarily related to dosage or blood pressure changes.

A comparative series of 35 patients undergoing major gynaecological surgery and receiving triflupromazine, and 35 not receiving it showed a reduction in emergence vomiting and/or restlessness of 30 per cent.

Discussion

The failure of the drug to prevent emergence vomiting and restlessness in all cases could be attributed to incorrect dosage and time of injection. Intramuscular instead of intravenous administration would reduce this difficulty. However, the fact that failures occurred with high dosage suitably timed and in the absence of any other obvious reasons for these complications suggests that this is not the only reason for lack of success. Significant falls in blood pressure sometimes occurred with the lowest doses indicating that intramuscular administration in amounts certain to be effective would probably produce an unexpected hypotension in a minority of cases subsequently in the recovery room. This experience was reported by Davies (4). Consequently, slow intravenous injection seems the most desirable method of administration.

Although in a minority of patients suffering from coronary arterial disease, with or without hypertension, substantial falls in blood pressure occurred, the majority of these patients tolerated the drug well. There was no increase in morbidity and the relative advantages and disadvantages of its administration to these patients remain to be elucidated.

Conclusion

Triflupromazine used as described is effective in the prophylaxis of emergence vomiting and restlessness. In a minority of patients a significant fall in blood pressure is caused and this possibility should be borne in mind when the drug is used.

Summary

Prophylactic treatment of emergence vomiting and restlessness is considered to be indicated when these complications will endanger the patient's life or the operative site. This is particularly the case in plastic and ophthalmic surgery and in patients suffering from coronary arterial insufficiency. The cautious intravenous administration of triflupromazine in dosage 0.1–1.0 mg./10 lb. body weight prior to the termination of anaesthesia reduced the incidence of these complications. Significant depression of the blood pressure was unusual and when it did occur was unrelated to the dosage used.

Acknowledgment

I am grateful to Dr. E. A. Gain, M.D., Director of the Department of Anaesthesia, University Hospital, Edmonton for his help and encouragement.

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DECIMAL CLASSIFICATION FOR AN ANAESTHETIC FILING SYSTEM

J.-P. BRUNELLE, M.D.

EVERY PHYSICIAN evolves a more or less elaborate system of references that he feels will come in handy in preparing a lecture, case report, or publication. This filing system should be simple, labour-saving and capable of unlimited expansion for maximum benefits to its user. The Dewey Decimal Classification System fulfils these requirements. It thus appeared desirable to adapt this system which is used in major libraries to the field of anaesthesia as well.

The field of anaesthesia is divided into nine main classes numbered 1 to 9, and subjects so general as to belong to none of these classes are marked 0 and form a tenth class. These classes are then considered independently and each is separated again into nine divisions. Thus 72 designates division 2, Ventilatory Resuscitation, of class 7, Resuscitation. A third classification is made by separating each of these divisions into nine sections numbered in the same way. Thus 721 represents section 1, Artificial Respiration, of division 2, Ventilatory Resuscitation, of class 7, Resuscitation. This decimal subdivision is repeated until it secures as many subsections as may be needed in any topic.

Theorically, division of every subject into just nine parts is impossible; harmony and exactness repeatedly have to be sacrificed to practical requirements. When more than nine divisions are needed, the difficulty is commonly obviated by assigning 1–8 to subjects grouped on 9 as "others. . . ."

The following tables, by no means complete, for want of space, will illustrate the system and serve as a starting point for those who wish to adapt such a system to their anaesthesia files.

FIRST SUMMARY

CLASSES

000	**General considerations**	**500**	**Fluid therapy**
100	**Basic sciences**	**600**	**Pre-, per-, and post-anaesthetic periods**
200	**General anaesthesia**	**700**	**Resuscitation**
300	**Conduction anaesthesia**	**800**	**Inhalation therapy**
400	**Special anaesthetic techniques**	**900**	**Anaesthesia for non-surgical conditions**

SECOND SUMMARY

DIVISIONS

000	**General considerations**	040	**Medico-legal considerations**
010	**History, biographies**	050	**Economic considerations**
020	**Bibliography**	060	**Operating and anaesthetic rooms**
030	**Anaesthetic records, statistics**	070	**Anaesthetic instruments and their care**

[1]Department of Anaesthesia, Notre Dame Hospital, and Queen Mary Veterans' Hospital, Montreal, P.Q.

080 Researches in anaesthesia
100 Basic Sciences
110 Pharmacology
120 Physiology
130 Anatomy
140 Bio-Chemistry
150 Physics
200 General anaesthesia
210 Theories
220 Signs and stages
230 Methods
240 Special methods
250 Complications
300 Conduction anaesthesia
310 General considerations
320 Technique of nerve blocking
330 Diseases managed with blocks
340 Adjuvants to analgesic blocking
400 Special anaesthetic techniques
410 Age considerations
420 Pre-anaesthetic status
430 In various types of surgery
440 Hypothermia
450 Control of bleeding
460 Pulmonary ventilation
470 Controlled circulation
480 Muscle Relaxation
500 Fluid Therapy
600 Pre-, per, and post-anaesthetic periods
610 Pre-anaesthetic period
620 Per-anaesthetic period
630 Post-anaesthetic period
700 Resuscitation
710 Conditions requiring resuscitation
720 Ventilatory resuscitation
730 Circulatory resuscitation
740 First aid equipment
750 Analeptics
800 Inhalation therapy
900 Anaesthesia for non-surgical conditions

THIRD SUMMARY

SECTIONS

000 General considerations
100 Basic sciences
110 Pharmacology
111 *Central nervous system depressants*
112 *Central nervous systems stimulants*
113 *Local anaesthetics*
114 *Autonomic drugs*
115 *Curare*
116 *Histamine and antihistaminic agents*
117 *Cardiovascular drugs*
118 *Locally acting drugs*
120 Physiology
121 *Body water and body fluids*
122 *Blood*
123 *Heart and circulation*
124 *Respiration*
125 *Nervous system*
126 *Autonomic nervous system*
127 *Metabolism*
130 Anatomy
140 Bio-chemistry
150 Physics
200 General anaesthesia
210 Theories
220 Signs and Stages
230 Methods
231 *Inhalation anaesthesia*
232 *Anaesthesia by intravascular injection*
234 *Rectal anaesthesia*
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242 *Combined anaesthesia*
243 *Hypnosis*
244 *Electro-narcosis*
245 *Controlled narcosis*
250 Complications
300 Conduction anaesthesia
310 General considerations
320 Technique of nerve blocking
321 *Blocking cranial nerves*
322 *Blocking somatic spinal nerves*
323 *Blocking autonomic nervous system*
324 *Subarachnoid block*
325 *Peridural block*
326 *Local block*
327 *Differential block*
328 *Intracisternal injection*
330 Diseases managed with blocks
340 Adjuvants to analgesic blocking
400 Special anaesthetic techniques
410 Age considerations
411 *Paediatric anaesthesia*
412 *Geriatric anaesthesia*
420 Pre-anaesthetic status
430 In various types of surgery
440 Hypothermia
450 Control of bleeding
460 Pulmonary ventilation
461 *Controlled respiration*
462 *Mechanical control of respiration*

463 *Diffusion respiration*
464 *Hypoventilation and hyperventilation*
470 **Controlled circulation**
471 *Extracorporeal circulation*
472 *External pacemaker*
480 **Muscle relaxation**
500 Fluid therapy
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610 **Pre-anaesthetic period**
611 *Evaluating patient*
612 *Preparing patient*
613 *Preparing equipment*
620 **Per-anaesthetic period**
621 *Induction*
622 *Maintenance*
623 *Awakening*
624 *Positioning patient*
625 *Complications*
630 **Post-anaesthetic period**
631 *Recovery*
632 *Postoperative rounds*
633 *Postoperative care*
634 *Complications*
700 Resuscitation
710 **Conditions requiring resuscitation**
711 *Cardiovascular emergencies*
712 *Respiratory emergencies*
713 *Drug intoxication*
714 *Asphyxia neonatorum*
715 *Tetanos*
720 **Ventilatory resuscitation**
721 *Artificial Respiration*
722 *Tracheotomy*
730 **Circulatory resuscitation**
740 **First aid equipment**
750 **Analeptics**
800 Inhalation therapy
900 Anaesthesia for non-surgical conditions

COMPLETE TABLES INCLUDING SUBDIVISIONS

000 General considerations
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020 **Bibliography**
030 **Anaesthetic records, statistics**
040 **Medico-legal considerations**
050 **Economic considerations**
060 **Operating and anaesthetic rooms**
070 **Anaesthetic instruments and their care**
080 **Researches in anaesthesia**
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111 *Central nervous system depressants*
111.1 General anaesthetics
111.11 Volatile liquids
111.111 Ethers
111.111.1 Diethyl-ether
111.111.2 Vinethene
111.111.3 Vinamar
111.111.4 Metopryl
111.111.5 Isopryl
111.111.6 Fluorinated ethers
111.111.61 Fluoromar
111.111.62 Fluothane
111.112 Chloroform
111.113 Ethyl chloride
111.114 Trilene
111.115 Isopropyl chloride
111.116 Vinyl chloride
111.12 Gases
111.121 Nitrous oxide
111.122 Ethylene
111.123 Cyclopropane
111.124 Cyclobutane
111.125 Cyclopentane
111.126 Cyclohexane
111.127 Acethylene
111.128 Xenon
111.2 Basal anaesthetics
111.21 Tribromethanol
111.22 Trichlorethanol
111.3 Aliphatic alcohols and antabuse
111.4 Hypnotics and sedatives
111.41 Barbiturates
111.411 Long-acting barbiturates
111.412 Moderate duration barbiturates
111.413 Short-acting barbiturates
111.414 Ultra-short-acting barbiturates
111.414.1 Pentothal
111.414.2 Surital
111.414.3 Kemital
111.414.4 Neraval
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111.414.6 Thiogenal
111.414.7 Baytinal
111.414.8 Evipan
111.414.9 Others. . . .
111.414.91 Venesetic
111.414.92 Eunarcon
111.414.93 Narconumal
111.42 Bromides
111.43 Chloral hydrate
111.44 Paraldehyde
111.45 Dormison
111.46 Urethan
111.47 Mescaline
111.48 Bulbocapnine
111.49 Others. . . .
111.491 Valmid

111.492 Noludar
111.493 Doridene
111.5 Centrally acting muscular relaxants
111.51 Mephenesin
111.52 Artane
111.53 Panparnit
111.54 Diparcol
11.55 Parsidol
111.6 Narcotics
111.61 Alcaloids of opium
111.611 Morphine
111.612 Codeine
111.613 Thebaine
111.614 Papaverine
111.615 Narcotine
111.616 Narceine
111.62 Synthetic narcotics
111.621 Demerol
111.622 Nisentil
111.623 Methadone
111.624 Levorphan
111.625 Leritine
111.626 Percodan
111.627 Dimorlin
111.628 Heptacyclaine
111.63 Narcotic antagonists
111.631 Nalline
111.632 Levallorphan tartrate
111.633 Daptazole
111.7 Analgesics and antipyretics
111.8 Tranquillizing drugs
111.81 Piperazine derivatives
111.811 Meretran
111.812 Frenquel
111.813 Atarax
111.814 Ritalin
111.82 Miltown
111.83 Dioxolane
111.84 Nostyn
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111.851 Phenergan
111.852 Largactil
111.853 Sparine
111.854 Pacatal
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111.86 Reserpine
111.87 Ultran
112 *Central nervous system stimulants*
112.1 Picrotoxine
112.2 Metrazol
112.3 Coramine
112.4 Strychnine
112.5 Camphor
112.6 Caffeine
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112.8 Theobromine
112.9 Others. . . .
112.91 Megimide
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113 *Local anaesthetics*
113.1 Cocaine
113.2 Novocaine
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113.4 Xylocaine
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113.94 Ravocaine
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113.97 Dyclonine
113.98 Carbocaine
113.99 Others. . . .
113.991 Hostacaine
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114.11 Choline esters
114.111 Acetylcholine
114.112 Metacholine
114.113 Carbachol
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114.12 Cholinesterase inhibitors
114.121 Physostigmine
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114.124 Tensilon
114.125 Mestinon
114.13 Pilocarpine
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114.2 Sympathomimetic drugs
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114.22 Levarterenol
114.23 Ephedrine
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114.25 Phenyledrine
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114.28 Wyamine
114.29 Others. . . .
114.291 Propadrine
114.292 Methedrine
114.293 Isoproterenol
114.294 Methoxyphenamine
114.295 Privine

114.296 Cyclopentamine
114.297 Isuprel
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114.31 Parasympathetic depressants
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114.336.1 Elvetil
114.336.2 Etamon
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114.337.1 Antilusin
114.337.2 Pendiomide
114.338 Hexamethonium
114.338.1 Vegolysen
114.338.2 Hexanium
114.338.3 Esomid
114.338.4 Hexathide
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115.1 Long-acting curare
115.11 D-tubocurarine
115.12 Curarine
115.13 Intocostrin
115.2 Medium-acting curare
115.21 Mediatonal
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115.23 Prestonal
115.3 Short-acting curare
115.31 Anectine
115.32 Brevidil
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115.4 Quinine and derivatives
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322.4 Median nerve block
322.5 Ulnar nerve block
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325.4 Drugs used for peridural block
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325.6 Technique
325.7 Complications
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326.1 Local infiltration
326.2 Topical application
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625.5 Metabolism
625.6 Autonomic reflexes
625.61 Oculo-cardiac reflex
625.62 Carotid sinus reflex
625.63 Periosteal reflex
625.64 Somatic nerve traction reflex
625.65 Respiratory tract reflexes
625.66 Intrathoracic reflexes
625.67 Abdominal reflexes
625.7 Anaphylactic reactions
625.8 Death during anaesthesia
625.9 Others. . . .
625.91 Chemo-physiologic alterations
625.92 CO_2 accumulation
625.93 Anoxia
625.94 Drug incompatibilities
630 **Post-anaesthetic period**
631 *Recovery*

632 *Postoperative rounds*
633 *Postoperative care*
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700 Resuscitation
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713 *Drug intoxication*
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713.2 Narcotic poisoning
714 *Asphyxia neonatorum*
715 *Tetanos*
720 Ventilatory resuscitation
721 *Artificial respiration*
721.1 Mouth to mouth
721.2 Manual methods
721.3 Mechanical methods
722 Tracheotomy
730 Circulatory resuscitation
740 First aid equipment
750 Analeptics
800 Inhalation therapy
900 Anaesthesia for non-surgical conditions

Referring to these tables, a number is given to the article to be classified. The title of the article with the name of the journal and its date of issue are written on a 4 × 6 inch filing card with the class number at the upper left corner, thus:

722
An anaesthetic technic for tracheostomy (R. Bryce-Smith) ANAESTHESIA–April 57, p. 152.

This reference and others are set out in numerical order in a small steel filing cabinet.

Sometimes, an article may be cross-filed under two or more headings according to points of interest and this makes possible a much more accurate classification of an article than when only one entry is used.

The class number for the present article is 030.

REFERENCE

DEWEY, MELVIL. Decimal Classification and Relative Index, 14th ed. Lake Placid Club, Essex County N.Y.: Forest Press Inc. (1942).

A SAFE AND ECONOMICAL METHOD OF ADMINISTERING FLUOTHANE IN CLOSED CIRCUIT ANAESTHESIA[1]

A. ROMAGNOLI, M.D., M. COHEN, M.D., and M. J. DIAMOND, M.B., CH.B.[2]

SINCE FLUOTHANE WAS DISCOVERED by Raventos (1–4) in 1956 a score of papers have appeared in the medical press, all seeking the least expensive and most accurate method of delivering this potent and very expensive agent in closed circuit anaesthesia (5–8).

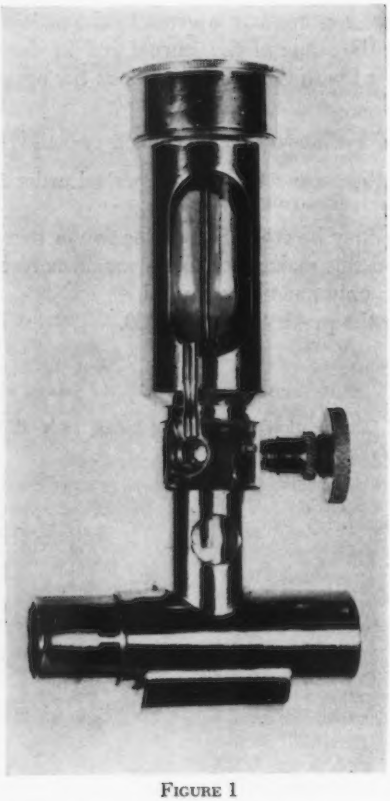

FIGURE 1

We, too, decided to seek a solution to this problem, and found that as Macintosh (9) suggested: "Probably the most accurate method of administering the vapour of a liquid anaesthetic in any desired concentration is to volatilize a calculated volume of the liquid in a known volume of air and to deliver the resultant

[1]Presented at the Canadian Anaesthetists' Society Annual Meeting, Montebello, P.Q., May, 1959.

[2]From the Department of Anaesthesia, Jewish General Hospital, Montreal, P.Q.

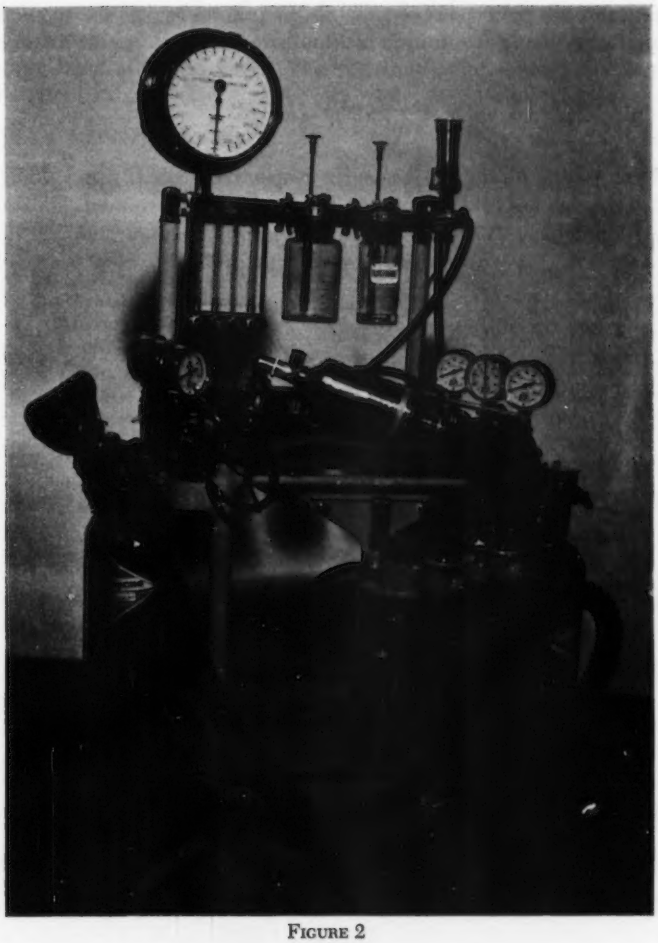

FIGURE 2

mixture to the patient. This method was used in animal experiments a hundred years ago by Snow and later was employed clinically by Clover." We have used a method based on this theory to administer Fluothane safely and economically in closed or semi-closed circuit anaesthesia. As a means of calculating accurate and minute amounts of the anaesthetic in question, we have availed ourselves of the Goldman's drip feed, an apparatus known particularly well to the British anaesthetist (Fig. 1). It is composed of a bottle containing the liquid anaesthetic, a dripping chamber below, connected to the bottle by a capillary tube and a needle valve which regulates the flow down to one or two drops per minute. The only modification which we made to this was the addition of a gauze wick in the lumen of the tube where the gases flow, immediately below the dripping chamber, so as to increase the vapourization of the Fluothane (Fig. 2). This apparatus is very versatile and fits most anaesthetic machines.

The Goldman's drip feed delivers 150 drops per cubic centimetre. To calculate the volume to volume concentration of Fluothane in the gaseous mixture, we used this formula:

$$\frac{V \quad SG}{MW} . 22.4 \text{ L. (N.T.P.)}$$

corrected for temperature and pressure, respectively 25°C., and 75.5 cm./Hg. Where *V* is the volume in drops of liquid vapourized per minute; *SG* the specific gravity of Fluothane; *MW* the molecular weight of Fluothane and 22.4 L., according to Avogadro's law is the volume of vapour produced by 1 gm. molecule of

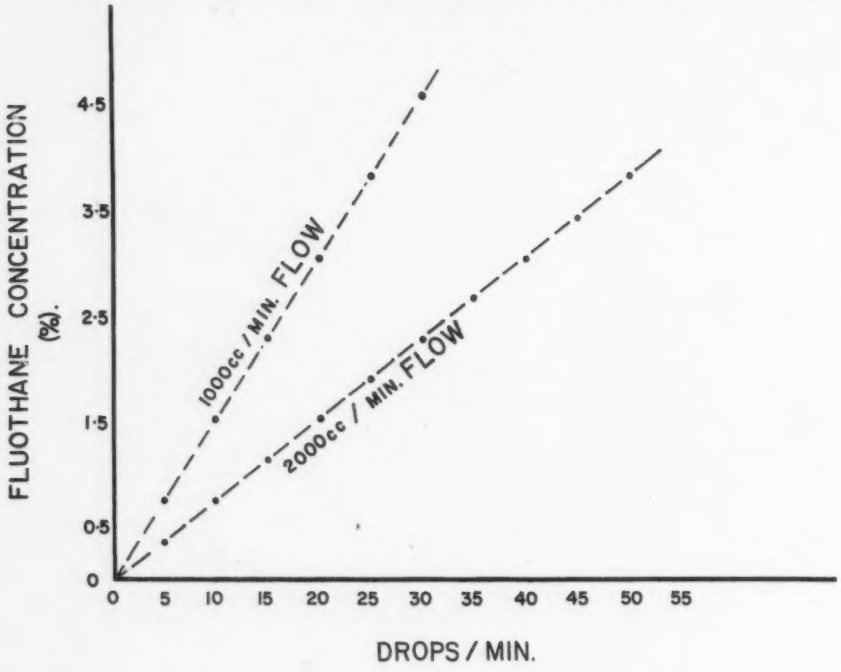

FIGURE 3

substance at N.T.P. The developed formula gave us 211 cc. of Fluothane vapour. In the practice of this method, it is advantageous to remember that 7.5 drops are equal to 0.05 cc. and to 10 cc. of vapour. Therefore, by adjusting the rate of drip in a known and constant flow of gas the volume to volume percentage is clear and accurate. This calculation can be seen on the diagram (Fig. 3) which we have made. On the abscissa, one reads the drops per minute and, on the ordinate, the v/v percentage. We have traced only 2,000 cc. and 1,000 cc. flows, but the method applies just as simply to any other flow above or below these figures. Moreover, we stress that this method is just as safe and accurate in total rebreathing as it is in any degree of partial rebreathing.

During the past two years there were well over 6,000 administrations of Fluothane at our hospital, 809 of which were done by this method. The patients varied in age from 10 to 83 years. The distribution of these cases by type of operation demonstrates the fact that they were all major ones:

Intrathoracic operations	4
Biliary tract operations	154
Bowel resections	73
Gastrectomies	63
Upper laparotomies	23
Lower laparotomies	81
Appendectomies	72
Intra-abdominal gynaecological operations	74
Kidney operations	35
Sympathectomies	9
Hernias	36
Prostatectomies	35
Mastectomies	33
Thyroidectomies	16
Orthopaedic operations	62
E.N.T. operations	7
Others	32
TOTAL	809

We need only add here that of the four intrathoracic operations, two were mitral valvulotomies and two were lung resections. The distribution of cases by time gives a total of 1,598 anaesthetic hours, and shows that many were lengthy procedures—491 being two hours or more:

Time (hrs.)	
1	318
2	299
3	116
4	52
5	18
6	6
TOTAL	809

In this series there were no deaths or complications which could be attributed to the anaesthetic or the method. The patients fared well in spite of the fact that some were acutely ill. These few facts demonstrate clearly the safety and the reliability of this method.

As to the economy, we can only say that, by means of this type of administration, the expenditure for Fluothane is 48¢ per hour delivering 7.5 drops per minute (the equivalent of 1.05 per cent in a 1 L. flow). In addition, the Goldman's drip feed is very inexpensive.

SUMMARY

A new method of administering Fluothane in closed circuit anaesthesia is presented. The Goldman's drip feed is used to measure minute amounts of the

drug accurately. In all, 809 cases were done. The simplicity and safety of the method are stressed, together with its economy.

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OBITUARIES

Dr. Thomas Russell Nichols

Dr. Thomas Russell Nichols died suddenly at his office in Stratford, Ontario, on November 12, 1959. Dr. Nichols was born in Stratford on April 18, 1900, son of the late Mr. and Mrs. Wm. Nichols. He served in the R.A.F. in 1918 and graduated M.B., University of Toronto, in 1924. After interning at Grace Hospital, Toronto, he began general practice in Stratford. Very early he showed his lifelong interest in anaesthesiology and, because of the high standards he set in all he undertook, very quickly established an enviable respect for his skill and judgment throughout Western Ontario. He pioneered in this district in the use of endotracheal anaesthesia, especially for tonsillectomy. He became Certificated in Anaesthesia in 1943. He was a Fellow of the American College of Anesthesiologists, a member of the American Society of Anesthesiologists and a member of the International Anaesthesia Research Society. He became a member of the Canadian Anaesthetists' Society early in his career and maintained his interest and support over the years.

Russell Nichols was truly a "doctors' doctor." His wealth of experience in all phases of general practice made him the guardian of the health and skills of his fellow practitioners and their families for years. He was physician to the Nursing School for over twenty-five years, and held nearly every office to be held in Stratford and Perth County Medical Societies.

With the establishment of the Department of Anaesthesia at the Stratford General Hospital, he became the first Chief, and remained in the position until 1956 when a lightening of his duties became advisable. His guiding judgment remained invaluable thereafter. He was a true friend, a dedicated teacher, and will be missed for many years to come.

Dr. Nichols was married to Elizabeth Shore in 1925 and sincere sympathy goes out to her, their son, Dr. Wm. R. Nichols of Pittsburgh, and their daughter, Elizabeth, Mrs. J. B. Hartley of Ottawa.

Dr. Norman McLeod Thornton

The death of Dr. Norman McLeod Thornton, at the age of 69, occurred in Vancouver, B.C., on January 11, 1960. Dr. Thornton graduated from the University of Manitoba in 1924, and following internship at the Vancouver General Hospital, did post-graduate study in England. For two years, he was a ship's doctor and then did general practice in Vancouver. In 1928, he joined the Anaesthetic Staff of the Vancouver General Hospital. He held this position until his retirement in 1956.

Dr. Thornton was a member of the Canadian Medical Association and the Canadian Anaesthetists' Society, and at the time of his death, was on the honorary attending staff of the Vancouver General Hospital.

He is survived by his widow and one son, Dr. Norman Thornton, Jr., who is at present in the Post-Graduate Course in Anaesthesia at McGill University.

BOOK REVIEWS

FLUID AND ELECTROLYTES IN PRACTICE. By HARRY STATLAND. Second edition. Montreal: J. B. Lippincott Co. $6.00.

THIS BOOK represents a very successful attempt to steer the suspicious novitiate through the complex waters of fluid and electrolyte balance. It is written in a straightforward manner and contains sufficient information for the trainee anaesthetist, without losing him in a morass of detail. For those interested in further reading, there is a bibliography of over 200 references—although these are not cross-indexed with the text.

The chapter on "Acid-Base Balance" is not adequate for the anaesthetist, the interrelations between metabolic and respiratory circumstances being sketchily handled with no mention of the diagrammatic representation of such parameters, for instance.

Perhaps an unusual feature in such texts, there is a satisfactory balance in the discussion between "surgical" and "medical" disorders—with the emphasis on the latter. As a how-to-do-it guide it appears very satisfactory.

Over-all, this book is highly recommended.

H.B.F.

CANADIAN ANAESTHETISTS' MUTUAL ACCUMULATING FUND LIMITED

The second fiscal year of the Fund ended September 30, 1959, and analysis has shown that performance during that year was at least equal to other Canadian mutual funds, and in most instances much better, despite the market decline of the late summer and autumn. The Board of Directors has continued the policy of no "front-end loading," and no penalty on redemption of shares.

The shares of the Fund are registered for sale to the public in all the provinces of Canada except Prince Edward Island and Newfoundland. Enquiries may be addressed to the Head Office of the Fund at the following address:

THE CANADIAN ANAESTHETISTS' MUTUAL ACCUMULATING FUND LTD.

178 St. George St., Toronto 5, Ontario

INTERIM STATEMENT, JANUARY 1, 1960

Assets

Current			
Cash		$ 15,755.95	
Accrued interest receivable		460.00	
Dividends receivable		575.00	$ 16,790.95
Investments in marketable securities (at market value) (Cost $355,861.94)			365,128.00
Organization expenses			9,209.75
			$ 391,128.70

Liabilities

Current			
Accrued liabilities			$ 1,682.11
Shareholders' deposits for investment			565.33
Provision for income tax			128.47

Shareholders' Equity

Capital stock			
Issued fully paid			
68,462 Class "A" shares of $1.00 each	$ 68,462.00		
8 Class "B" shares of $1.00 each	8.00	$ 68,470.00	
68,470			
Reserve for organization expense		9,209.75	
Reserve for redemptions		293,858.78	
Unrealized appreciation on investments	9,266.06		
Realized gain on investments	5,250.13	14,516.19	
Surplus			
Balance September 30, 1959	1,188.40		
Interim net gain October 1, 1959, to January 4, 1960	1,509.67	2,698.07	388.752.79
			$ 391,128.70

Value of shares January 4, 1960:
$388,752.79 + 68,470 = $5.68

Securities Held by the Fund

Bonds

Bicroft Uranium
Cdn. Delhi (conv.)
Faraday Uranium Mines
Greyhound (conv.)
Milliken Lake
Westcoast (conv.)

Shares

Preference

B.C. Electric
I.A.C.
Massey-Ferguson

Common

Abitibi Power & Paper
Algoma Steel Corporation
Aluminium Limited
Argus Corp.
Bank of Montreal
B.C. Power
Canadian Oil
Consolidated Paper
Consumers' Gas Co.
Dominion Foundries
Dominion Stores
Great Lakes Paper
Greyhound Lines of Canada
Howard Smith Paper Mills
Imperial Oil
I.A.C.
International Nickel Company
Interprovincial Pipe Line Co.
MacMillan & Bloedel "B"
Moore Corp.
Noranda Mines Limited
Page-Hersey Tubes
Simpson's Limited
Stedman Bros.
Steel Company of Canada
Superior Propane
Toronto-Dominion Bank
George Weston Ltd. B

NEWS LETTER

British Columbia Division

The 118 members of the most westerly division of the Society have enjoyed a most active programme in recent months. Economic problems were a major consideration in the closing months of 1959, but the emphasis changed to preparations for our role as host to the meeting of the Western Divisions of the Society, to be held in Victoria, April 28 to 30 this year.

Regular monthly meetings of the Division have provided the opportunity for members to hear the following speakers and topics:

Dr. T. D. Stout, Provincial Medical Director, Canadian Red Cross Blood Transfusion Service, speaking on "Changes and Problems in the Past Five Years in Blood Transfusion Service."

Dr. J. E. Merriman, Department of Medicine, University of Saskatchewan, discussing "Circulatory Dynamics in Health and Disease."

Dr. R. A. Gordon, Secretary-Treasurer, Canadian Anaesthetists' Society, giving a "Review of Problems of the Canadian Anaesthetists' Society."

Dr. R. G. B. Gilbert, Professor of Anaesthesia, McGill University, speaking about "Anaesthesia for Neurosurgery."

Dr. Lucien Morris, Professor of Anesthesiology, University of Washington, Seattle, reviewing "Pitfalls in the Use of Anaesthetic Apparatus."

In March, the New Westminster anaesthetists were hosts to the Division for the presentation of several papers by our own members.

The B.C. Division again this year provided a bursary to the University of British Columbia to aid a medical student chosen by the University.

Dr. A. K. Gibbons, Dr. David Allan, and Dr. R. S. Moir have joined the group of anaesthetists at the Burnaby and Grace Hospitals in Greater Vancouver. Dr. A. C. Blair has become the Director of the Department of Anaesthesia at Burnaby General Hospital, and Dr. J. J. Carroll is Director of Anaesthesia at Grace Hospital.

One of the long-time practitioners of anaesthesia in British Columbia was lost to us with the death of Dr. Norman McLeod Thornton on January 11, 1960, at the age of 69. Dr. Thornton, a 1924 graduate of the University of Manitoba, was on the anaesthetic staff of the Vancouver General Hospital from 1928 until his retirement in 1956.

Dr. L. C. Jenkins, who recently gained the Fellowship of the Royal College of Physicians of Canada, has now joined the partnership of Associated Anaesthetic Services in Vancouver.

Dr. Irene Millar and Dr. Tom Powell have joined the staff of the Vancouver General Hospital's Department of Anaesthesia.

The Post-Graduate Course in Anaesthesia sponsored by the staff of the Vancouver General Hospital and Sub-Section of Anaesthesia of the University of British Columbia was held January 27 to 29. Dr. R. G. B. Gilbert of Montreal was

the featured speaker, with a supporting faculty of 25 participants. This excellent course was attended by more than 60 doctors from the western provinces and states.

We anticipate the pleasure of seeing many of you at the Western Divisions Meeting in Victoria, April 28, 29, and 30.

Alberta Division

The Alberta Division of the Canadian Anaesthetists' Society met at the Macdonald Hotel, Edmonton, on September 29, 1959. The meeting was well attended and after the business meeting there was a buffet supper for members and their wives at the home of Dr. and Mrs. C. M. Learmonth.

The Calgary Anaesthetists' Society has been reorganized. The executive for this year is: *President*, Dr. J. Lawrence; *Secretary*, Dr. W. M. Jones; *Director*, Dr. W. Johns. A dinner meeting was held January 26 at which Dr. E. A. Gain was the guest speaker.

Saskatchewan Division

The Saskatchewan Division held a business meeting in Saskatoon on October 21, 1959, concurrent with the Annual Meeting of the College of Physicians and Surgeons of Saskatchewan.

The Government of Saskatchewan has announced a Medical Care Programme to be put in operation in 1961. This is subject to the result of the provincial election due in 1960. So far the medical profession of this province has recorded its unanimous opposition to a medical care programme which is completely under Government control.

Ontario Division

The anaesthetists of eight general hospitals in the suburbs of Toronto have formed a Society of Anaesthetists known as the Toronto Suburban Anaesthetists' Group. Meetings of the group to be held monthly, except during the summer months, at each of the suburban hospitals in turn. The members of the group are affiliated with the following hospitals: Queensway Hospital, South Peel Hospital, St. Joseph's Hospital, Northwestern Hospital, Branson Hospital, Humber Memorial Hospital, Oakville-Trafalgar Hospital and Scarborough General Hospital.

Dr. Stuart L. Vandewater has been appointed Associate Professor and Chief of the Department of Anaesthesia at Queen's University, Kingston, and Chief of the Department of Anaesthesia at Kingston General Hospital.

Dr. Raymond L. Matthews and Dr. Brian M. Marshall have been appointed to the Department of Anaesthesia of the University of Toronto and to the attending staff of the Toronto General Hospital.

The Tariff Committee of the Ontario Division has prepared a fee schedule on a procedural basis for presentation to the Tariff Committee of the Ontario Medical Association.

Newfoundland Division

In November, 1959, the Newfoundland Division was honoured by a visit from Dr. R. A. Gordon. This visit was jointly sponsored by the Newfoundland Division and the College of General Practice. Doctor Gordon took an active part in the convention of the College of General Practice by giving a paper entitled "Pre-Anaesthetic Evaluation of the Patient" and sitting in on a round table discussion of "New Drugs."

The local division gave a dinner at Baly Haly Golf and Country Club. On this occasion only members of the local division and Dr. Gordon were present. Following the dinner, a film, *The Big Island*, was shown by kindness of the Canadian National Railway. The evening concluded with informal discussion of anaesthetic problems, both clinical and economical. Dr. Gordon's visit here was greatly appreciated and our only regret was that it was not long enough for more leisure moments.

Dr. C. U. Henderson attended the Maritime Anaesthetic Meeting in April 1959.

Dr. T. G. Stentaford attended the annual meeting of the Canadian Anaesthetists' Society at the Seigniory Club.

Dr. C. D. Kean attended the joint meeting of the Canadian and British Medical Societies in Edinburgh.

Dr. Robert Macdonald joined the Newfoundland Anaesthesia Associates in May, 1958, and was successful in passing his certification examinations.

Dr. John Tyl also joined the Newfoundland Anaesthesia Associates in January, 1960.

Dr. Alan Simpson finished his residency at the St. John's General Hospital in June, 1959, and continued his training in Montreal.

Dr. John Francis finished his residency at the St. John's General Hospital in September, 1959, and moved to the Stephenville Cottage Hospital in a position of general practice.

Dr. John McGrath joined the residency staff at the St. John's General Hospital in October, 1959.

Meetings

WESTERN DIVISIONS

CANADIAN ANAESTHETISTS' SOCIETY

EMPRESS HOTEL, VANCOUVER, B.C.

April 28-29-30, 1960

SECOND WORLD CONGRESS OF ANAESTHESIOLOGISTS
WORLD FEDERATION OF SOCIETIES OF ANAESTHESIOLOGISTS

ROYAL YORK HOTEL, TORONTO, ONTARIO

September 4-10, 1960

1960 CONVENTION

WESTERN DIVISIONS OF THE CANADIAN ANAESTHETISTS' SOCIETY

EMPRESS HOTEL, VICTORIA, B.C.

April 28, 29, 30, 1960

DRAFT PROGRAMME

TOPIC: HYPOXIA

Thursday, April 28

Chairman: DR. R. E. SIMPSON

8:30– 9:30 A.M. REGISTRATION

9:30–10:30 A.M. The Development of the Present Concept of Hypoxia—Dr. C. B. Courville, Director, Cajal Laboratory

10:30–11:00 A.M. A Look at Current Ideas on Hypoxia—Dr. R. P. Harbord; Leeds

11:00–11:30 A.M. Exhibits; Coffee

11:30–12:30 A.M. The Problems of Hypoxia and Space—Wing Commander R. H. Lowry, M.D., Manager of Aero-Space Division, Boeing Airplane Co., Seattle, Wash.

Lunch and golf

Friday, April 29

Chairman: DR. H. B. GRAVES

9:00– 9:30 A.M. Paranatal Hypoxia and Its Degenerative Sequelae—Dr. C. B. Courville

9:30–10:00 A.M. Respiratory Problems in the Newborn—Dr. S. Segal, Director, Paediatric Research, U.B.C.

10:00–10:30 A.M. The Hypoxic Child—Dr. B. D. Graham, Professor of Paediatrics, U.B.C.

10:30–11:00 A.M. Exhibits; Coffee

11:00–11:30 A.M. A Plan for Management of Acute Hypoxia—Dr. G. Wyant, Professor, Department of Anaesthesia, University of Saskatchewan

11:00–12.00 A.M. Resuscitation: A Panel Discussion—*Moderator*, Dr. R. P. Harbord; *Panel*, B. D. Graham, G. Wyant, W. L. Esdale, S. Segal

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Chairman: DR. R. G. REVELL

2:00– 2:30 P.M. The Heart in Hypoxia and Ischaemia—Dr. H. H. Macartney, Department of Anaesthesia, U.B.C.

2:30– 3:00 P.M. The Hypoxic Kidney—Dr. Edwin Henry, Department of Medicine, U.B.C.

3:00– 3:30 P.M. Exhibits; Tea

3:30– 4:00 P.M. The Hypoxic Liver—Dr. J. E. Merriman, Department of Medicine, University of Saskatchewan

4:00– 5:00 P.M. The Hypoxic Soul—Dr. J. H. Harland

Saturday, April 30

Chairman: DR. F. A. TURNBULL

9:00– 9:30 A.M. A Study of the Cerebral Circulation—Dr. C. E. G. Gould, Professor, Neurology, U.B.C.

9:30–10:00 A.M. Electrographic Reflections of Hypoxia—Dr. Wm. Gibson, Professor, Neurological Research, U.B.C.

10:00–10:30 A.M. Coffee

10:30–11:00 A.M. The Sequelae of Cardiac Arrest: A Follow-up—Dr. C. D. Elton, Department of Anaesthesia, University of Alberta

11:30–12:30 A.M. Pulmonary Ventilation and Hypoxia—Dr. R. P. Harbord

EXAMINATION RESULTS

THE FOLLOWING CANDIDATES were successful in the 1959 Examinations of the Royal College of Physicians and Surgeons of Canada in the Specialty of Anaesthesia.

EXAMINATION FOR FELLOWSHIP OF THE ROYAL COLLEGE OF PHYSICIANS OF CANADA MODIFIED FOR ANAESTHESIA

CAMPBELL, Dr. J. M., Toronto, Ont.
HANLEY, Dr. T. R., Toronto, Ont.
JENKINS, Dr. L., Vancouver, B.C.

EXAMINATION FOR CERTIFICATION IN ANAESTHESIA

ALLAN, Dr. D., Vancouver, B.C.
BIRCH, Dr. J. H., Cleveland, Ohio, U.S.A.
BIRON-BEAUDRY, Dr. P., Montreal, P.Q.
BOUTROS, Dr. A. R., Montreal, P.Q.
BYK, Dr. A. A., Montreal, P.Q.
CLANCY, Dr. P. R., London, Ont.
CLARK, Dr. R. F., Trail, B.C.
CONDON, Dr. R. C., Winnipeg, Man.
DAIGLE, Dr. J. E., Moncton, N.B.
DALES, Dr. J. W., Clarkson, Ont.
DAVIDSON, Dr. J. W., Toronto, Ont.
DIAMOND, Dr. E. G., Calgary, Alta.
DOUGAN, Dr. A. A., Lennoxville, P.Q.
FARLEY, Dr. J. F., Edmonton, Alta.
FRASER, Dr. B. A., Cooksville, Ont.
GARD, Dr. M. A., Winnipeg, Man.
GIBBONS, Dr. A. K., Vancouver, B.C.
HARPER, Dr. I., North York, Ont.
HENRY, Dr. E. R., Victoria, B.C.
HILL, Dr. F. W., Calgary, Alta.
HORNE, Dr. G. R., Montreal, P.Q.
HOULD, Dr. R., Quebec City, P.Q.
JOHNSTON, Dr. H. J., Moose Jaw, Sask.
JONES, Dr. W. M., Calgary, Alta.
KILBORN, Dr. R. M., Kitchener, Ont.
KINSMAN, Dr. G. W., Saskatoon, Sask.
KIRKEBECK, Dr. E., Calgary, Alta.
LACASSE, Dr. J.-G., Chicoutimi, P.Q.
L'ALLIER, Dr. R., Montreal, P.Q.
LAVALLÉE, Dr. J. P., Montreal, P.Q.
LLOYD, Dr. E. A. C., Durham, N.C., U.S.A.
McCAMMON, Dr. J., Winnipeg, Man.
MACDONALD, Dr. D. A. C., Charlottetown, P.E.I.
MACDONALD, Dr. R., St. John's, Nfld.
MATTHEWS, Dr. R. L., Toronto, Ont.
MILLAR, Dr. I. E., Vancouver, B.C.
PELLETIER, Dr. J. N. J., Quebec, P.Q.
POWELL, Dr. T. E., Vancouver, B.C.
RENWICK, Don Mills, Ont.
SCHUH, Dr. O. W., Fort William, Ont.
SHOONER, Dr. J. T. F., Montreal, P.Q.
SLATER, Dr. P. E., London, Ont.
SPACKMAN, Dr. R. R., Cardston, Alta.
STEWART, Dr. R. J., Edmonton, Alta.
TENNENT, Dr. H. L. S., Winnipeg, Man.
WALLER, Dr. C., Hamilton, Ont.
WATSON, Dr. C. M., Edmonton, Alta.
WILSON, Dr. W. W., Thornhill, Ont.
WYNANDS, Dr. J. E., Montreal, P.Q.

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ANAESTHETIC NEWS

The History of Anaesthesia

PART II *From Humphrey Davy to Crawford Long*

Of the millions of operations performed each year, some are certain to result in death. But every year the risk decreases as new cures, medicines, treatments are discovered; as improved equipment provides more safety in surgery. How do our yearly successes rate with those of the early nineteenth century? In this era the pioneers of medicine and anæsthesia were engaged in daily conflict against unknown elements.

With the fabrication of the first "gas machine" in 1799, Humphrey Davy opened up new vistas for experimentation. The dangers were many when dealing with these unknown gases. In an article published in 1818, Michael Faraday warns:

> It is necessary to use caution in making experiments of this kind. By the imprudent inspiration of ether, a gentleman was thrown into a very lethargic state, which continued with occasional periods of intermission for more than 30 hours, and a great depression of spirits; for many days the pulse was so much lowered that considerable fears were entertained for his life.

However the results were not always detrimental. In the United States many itinerant "professors" of chemistry demonstrated the exhilarating effects of nitrous oxide—with audience participation. The young volunteers became pleasantly drunk, lost their sense of equilibrium, talked foolishly and sometimes laughed with complete abandon. Soon the audiences amused themselves without accompanying lectures, indulging in "Laughing-gas parties" and "Ether frolics."

The lighter side of these experiments soon reaped important results. In 1842, William E. Clarke, a young student of chemistry who often arranged "ether entertainment" for his companions, administered ether from a towel to a young woman called Miss Hobbie. . . . One of her teeth was then extracted without pain by a dentist, Dr. Elijah Pope. This would appear to be the first use of anæsthesia on record.

It was only two months after this outstanding success in the science of anæsthesia that a young physician, Crawford W. Long of Jefferson, Georgia, performed an operation to remove a tumor in the neck. His patient, James M. Venable, was under the influence of ether. The operation was completely successful with the patient feeling neither the surgeon's knife nor any pain.

Crawford Long's successful experimentation with ether was another milestone on the road to today's high standards of anæsthetic procedure and equipment. The years following were crowded with discoveries in this field, but most important in our eyes was the fabrication of Dr. Boyle's anæsthetic apparatus in 1917. The machine was close to perfection. So close that today, British Oxygen Canada has retained the original design, only modernizing and modifying it to a small extent. This is the B.O.C. Boyle machine now recognized by anæsthetists as the finest equipment of its kind in the world. It, together with other anæsthetic equipment and attachments, anæsthetic sundries, medical gases and *dependable service*, makes good the boast of fine quality in all British Oxygen Company products.

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Anæsthesia

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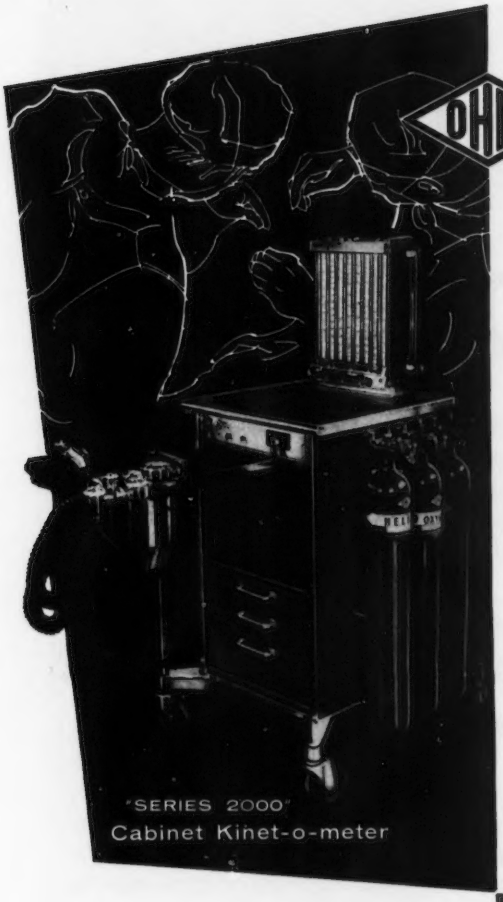

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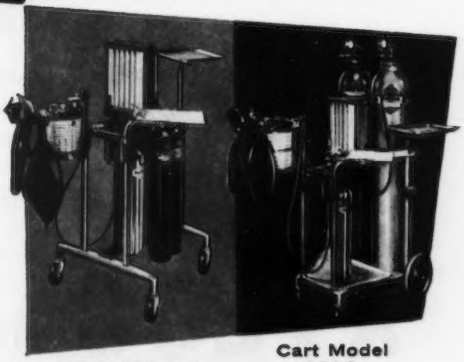

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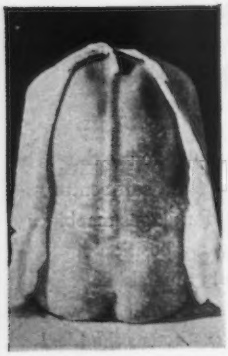

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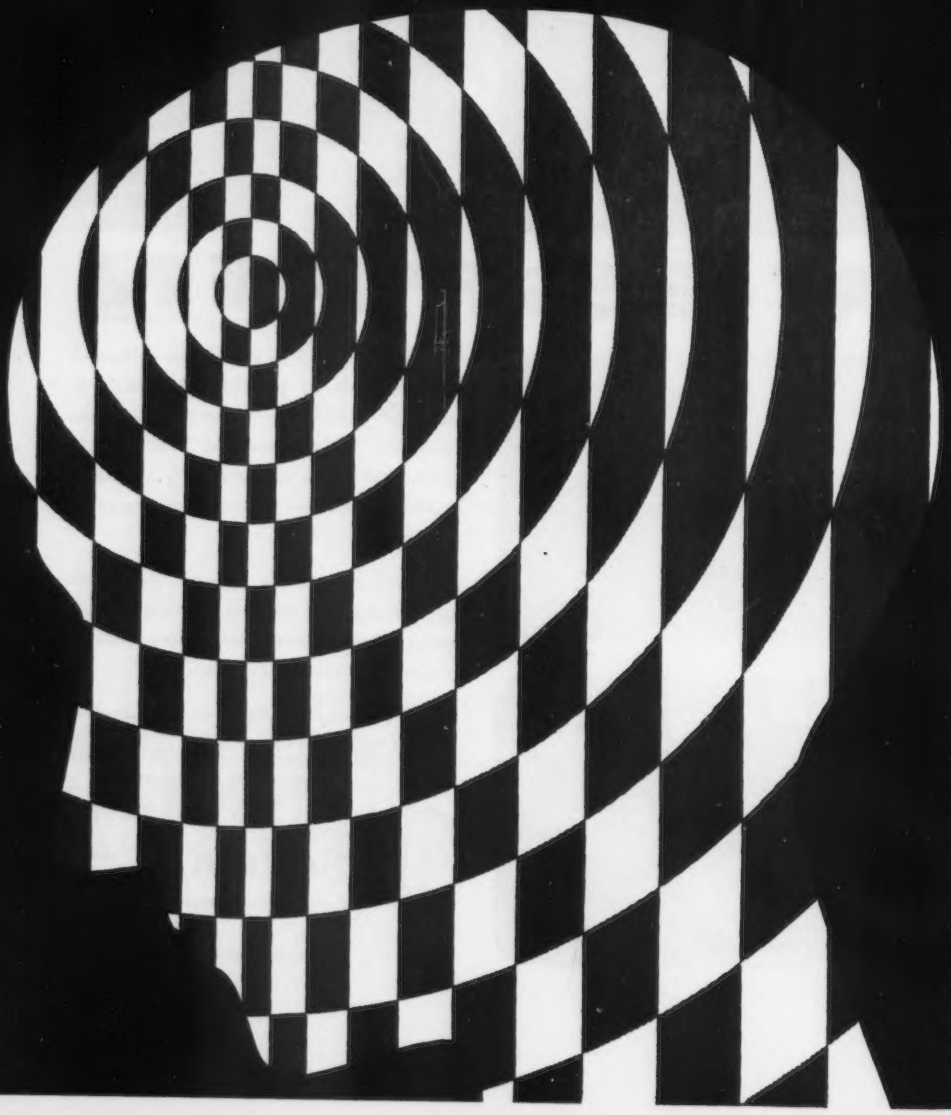

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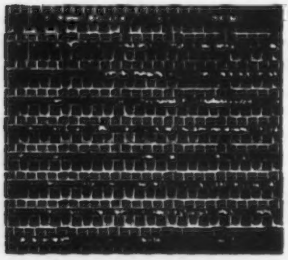

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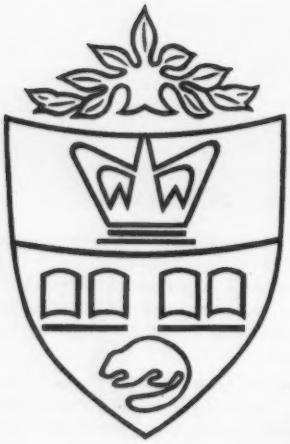

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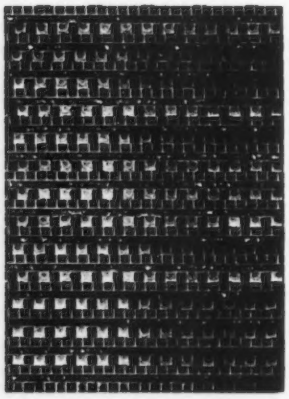

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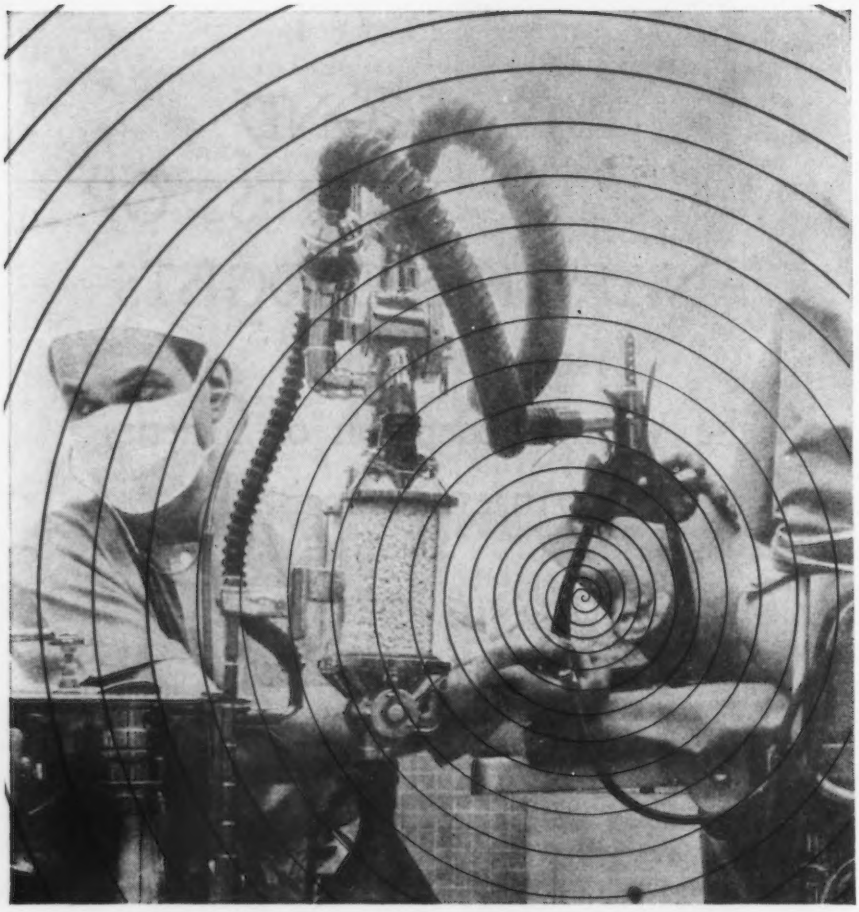

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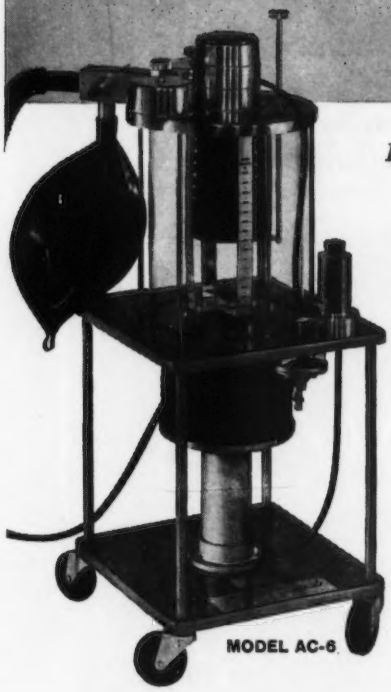

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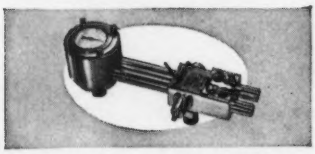

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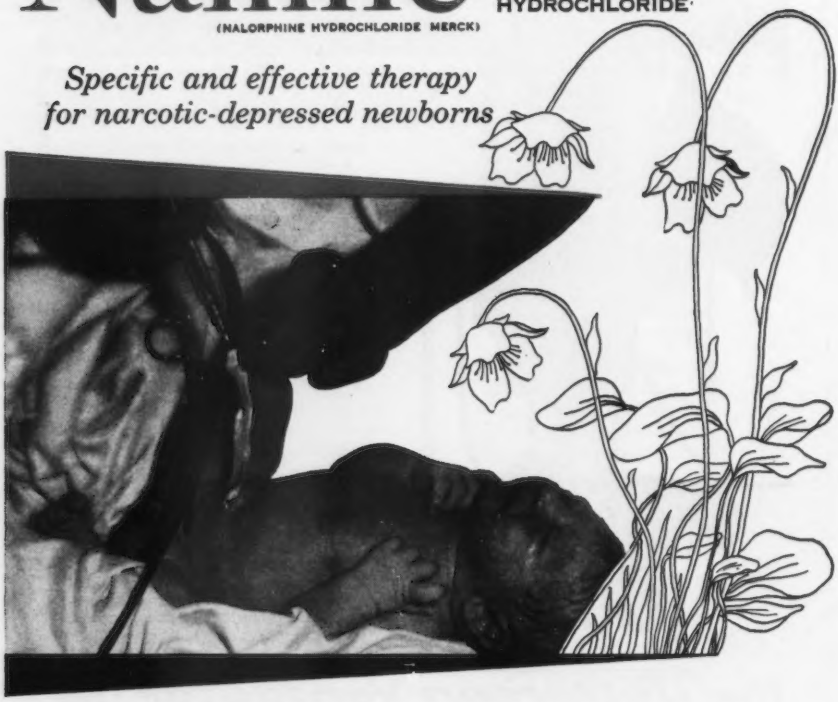

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